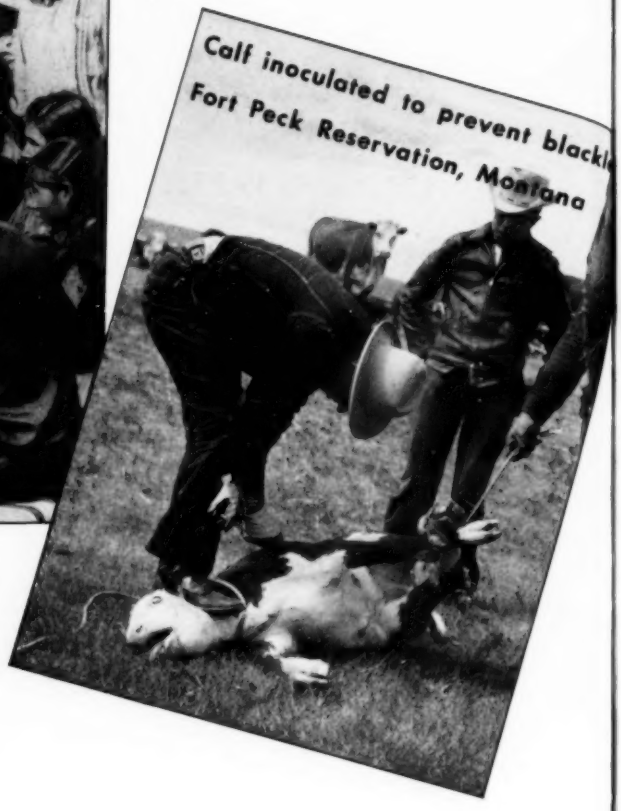
PUBLIC HEALTH REPORTS

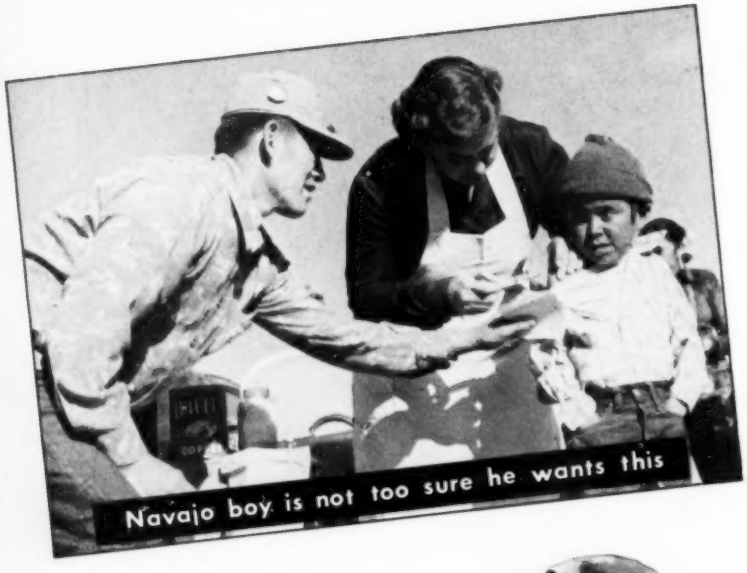
In this issue

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service

Health demonstration on Navajo reservation



Calf inoculated to prevent blackl
Fort Peck Reservation, Montana



Navajo boy is not too sure he wants this

Indian Health Activities

Navajo women dipping sheep to destroy ticks and lice

Room US,96 P4r
v.70 no.8

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frontispiece

Health of Indians became the responsibility of the Public Health Service Bureau of Medical Services July 1, 1955. (Photographs from the Department of the Interior.)

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U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
MARION B. FOLSOM, *Secretary*

PUBLIC HEALTH SERVICE
LEONARD A. SCHEELE, *Surgeon General*

Responses to Smallpox Vaccination in Military Recruits

By SUNG J. LIAO, M.D.

THE IMMUNITY of young men to contagious diseases is being studied in a group of recruits from the Army, the Navy, and the Air Force, and preliminary and secondary reports of a survey of this group carried out during April–June 1951 have been submitted to the Surgeon General of the Army. These reports include details of the manner in which the vaccination survey was conducted and definitions of the geographic divisions of this country and of the home communities of the recruits. Reports have been published on the results of Schick tests in relation to geographic origin and residence (*1*) and on the results of mumps complement fixation tests (*2*).

The survey reported here was carried out to determine the results of smallpox vaccination as practiced by the Armed Forces under conditions existing in early 1951 and to consider how such measurements can be used as a national index of certain vaccination practices. It was felt that this group, although subject to some bias in its selection, was nevertheless quite representative of the population of the Nation. The study does not, of course, represent an investigation to determine how thoroughly all young adult males of this country have been vaccinated.

A number of attempts have been made to review the extent of mass immunity against smallpox in the population of this country. Collins (*3*) found that, for the 4-year period 1928–31, 54 percent of almost 40,000 individuals of all ages residing in various parts of this country had been vaccinated. Of the males in his series, 65 percent of 2,415 individuals aged 15–24 years had been vaccinated, and 4 percent of the same group stated that they had had a clinical attack of smallpox.

Bull and Rankin (*4*) analyzed the records of 5,488 students who were vaccinated between 1924 and 1936 after admission to Lehigh University. Only 193 (3.5 percent) had not been vaccinated before entering the university, and 7.5 percent of the entire group gave a primary reaction to vaccination. Loy and Husband (*5, 6*), in 1936 and 1937 found that 75 percent and 78 percent of two groups of students of about 1,000 each had been vaccinated before entering another university. They came mainly from rural areas and small towns of Kansas. About 60–65 percent of them were considered "susceptible to vaccination," as shown by a primary or a vaccinoid reaction.

More recent information on the response to smallpox vaccination of the general population of this country is rather fragmentary. I have been unable to find a report based on data collected within the past 20 years on a nationwide

Dr. Liao, an assistant professor of preventive medicine at Yale University School of Medicine at the time this study was made, is at present a fellow in training in physical medicine at the Massachusetts General Hospital, Boston, Mass. *The work reported was done under the auspices of the section of preventive medicine, Yale University School of Medicine, for the Commission on Virus and Rickettsial Diseases, Armed Forces Epidemiological Board, with the assistance of officers of the Armed Forces.*

basis; therefore, the results of the present study might be considered to be a progress report on a national basis.

The manner in which this vaccination survey was conducted has been similar to that recorded in earlier reports to the Surgeon General of the Army. All of the recruits were males. The only criteria of selection were: (*a*) that the recruit be able to recall whether or not he had been vaccinated before admission to the military services and, if so, when; and (*b*) that the results of the current vaccination could be evaluated by the group making this study. Throughout this paper, the term "current vaccination" is used to mean the smallpox vaccination done by Armed Forces personnel when this survey was conducted in 1951.

About 95 percent of the entire group examined were between 17 and 22 years of age. The recruits came chiefly from the North Central and the Southern States and were more or less evenly distributed among urban, town, and rural communities. All were apparently in good health and none reported a clinical attack of smallpox.

Smallpox Vaccination

The recruits who were entering the Army, the Navy, or the Air Force, were vaccinated at the processing centers when they were inducted—2 to 7 days, usually 4 days—prior to their arrival at the training camps where the surveys were conducted. These training camps were: Fort George G. Meade, Md.; Aberdeen Proving Grounds, Md.; Lackland Air Force Base, Texas; and Great Lakes Naval Training Center, Ill. The actual vaccination procedure was carried out by medical personnel of the Armed Forces. The vaccination responses were read by a group of third- and fourth-year medical students from the Yale University School of Medicine and were recorded twice. The first reading was usually taken 5 to 9 days after the vaccination and the second reading, 4 days later. These readings were often supplemented by examining the immunization records of the recruits for reports of earlier readings made by others during the current period of observation.

Classification of the responses to smallpox vaccination was that recommended by Leake (*7*) and readings were evaluated, in relation to the time of vaccination, as "primary," "accelerated," and "immune" reactions. The corresponding terms preferred by some authors to describe similar types of responses to smallpox vaccination are "vaccinia," "vaccinoid," and "immediate" reactions. Each time the responses were read, measurements of the erythematous area were taken carefully, and the character and size of the vesicle or pustules were recorded.

In interpreting vaccination results, only the primary reaction was considered to be an indication of lack of specific immunity (*8*). No emphasis was laid on the accelerated and immune reactions for a number of reasons, some of which have been emphasized by Horgan and Haseeb (*9*). These authors have indicated that possible erroneous results may be due to differences in the skill of the operator and to the potency of vaccine lymphs. They suggested that such variations are even more important in revaccinations than in primary vaccinations. In line with these observations are those of Benenson, Kempe, and Wheeler (*10*), who demonstrated that even an inactivated lymph (containing no live vaccinia virus) could give accelerated or immune reactions in repeatedly vaccinated persons similar to the reaction induced by potent lymph, although the inactivated lymph could not provoke a rise of complement-fixing antibodies or hemagglutination inhibition antibodies characteristic of the potent lymph.

Results

In the evaluation of readings at the first interview during the immunity survey, 2,682 individuals were questioned with regard to their histories of previous smallpox vaccinations. The interview was usually supplemented by an examination for vaccination scars. Almost 10 percent had never been vaccinated before entering military service (table 1). About one-half had been vaccinated more than 10 years previously and almost one-third, within the last 10 years. Few could recall having been vaccinated more than once. None reported a clinical attack of smallpox.

Table 1. History of previous smallpox vaccination and evaluability of vaccination in 2,682 military recruits

History of previous vaccinations	Total recruits interviewed		Results of current vaccination			
			Not evaluable		Evaluable	
	Number	Percent [1]	Number	Percent [1]	Number	Percent [1]
Total	2, 682	100. 0	393	14. 65	2, 289	85. 35
>10 years [2]	1, 510	56. 30	213	7. 94	1, 297	48. 36
<10 years [3]	882	32. 88	122	4. 55	760	28. 33
Never before [4]	258	9. 62	52	1. 93	206	7. 69
Unknown [5]	32	1. 20	6	. 23	26	. 97

[1] All percentages are based on the total of 2,682.
[2] Vaccinated more than 10 years previously.
[3] Vaccinated within the last 10 years.
[4] Never vaccinated before induction into military service.
[5] Could not remember whether or not he had been vaccinated before.

The results of the current vaccination program in 393 recruits (15 percent of the entire group) could not be satisfactorily evaluated for various reasons. The major reason for the loss of these men from the series was that a good proportion of them were not vaccinated after entering military service. Another group of recruits reported that they had been vaccinated, although the results were not marked on their immunization records nor was any scarring detectable. A very few were absent at the second reading of the vaccination responses, either because of sickness or for other causes. Among those whose vaccination results could be evaluated, 26 persons could not give a definite statement about their previous smallpox vaccination. Thus, excluding the 419 individuals in these two categories, only 2,263 military recruits were included in the subsequent analyses.

Table 2 summarizes the history of previous vaccinations and the results of the current vaccination. About 18 percent of the entire group gave a primary reaction; 48 percent, an accelerated reaction; and 33 percent, an immune reaction. Among those who had never been vaccinated before, 85 percent gave a primary reaction. A higher percentage of primary reactors were observed among those who had been vaccinated more than 10 years previously than among those who had been vaccinated within the last 10 years, although the difference was not remarkable.

Distribution of the previously unvaccinated recruits according to their geographic origins

Table 2. History of previous smallpox vaccination and result of current vaccination of 2,263 military recruits

Previous vaccination history	Vaccinated recruits with definite history of vaccination	Reaction to vaccination					
		Primary		Accelerated		Immune	
		Number	Percent [1]	Number	Percent [1]	Number	Percent [1]
Total	2, 263	415	18. 3	1, 105	48. 4	760	33. 3
>10 years [2]	1, 927	163	12. 6	727	56. 0	407	31. 4
<10 years [3]	760	76	10. 0	343	45. 1	341	44. 9
Never before [4]	206	176	85. 5	[5] 25	12. 1	[5] 5	2. 4

[1] Percentage of total in each history group
[2] Vaccinated more than 10 years previously.
[3] Vaccinated within the last 10 years.
[4] Never vaccinated before induction.
[5] Vaccinated only once in the military services. Whether a different response could be obtained by further repeated vaccination was not investigated.

Table 3. Percentage distribution of 2,263 military recruits reporting no smallpox vaccination before induction, by type of community and geographic area of residence

Type of community	Total		Geographic area							
			Northeast		North Central		South		West	
	Number interviewed	Percent never vaccinated	Number interviewed	Percent never vaccinated	Number interviewed	Percent never vaccinated	Number interviewed	Percent never vaccinated	Number interviewed	Percent never vaccinated
Total	2,263	9.1	293	2.7	920	10.5	923	9.3	127	11.8
Urban	798	4.8	189	1.6	342	7.0	241	2.9	26	15.7
Town	839	9.4	86	4.6	349	10.9	356	8.2	48	16.7
Rural	626	14.2	18	5.6	229	15.3	326	15.7	53	5.6

and domiciliary communities is shown in table 3. Of the 293 persons from the Northeastern States, only 8 (2.7 percent) had never been vaccinated prior to induction. These 8 were more or less evenly distributed among urban, town, and rural districts. The occurrence of such a distribution by chance was approximately 1 in 3, with $x^2=1.35$.

Nine hundred twenty recruits came from the North Central States. Almost 11 percent had never been vaccinated previously. More, previously unvaccinated, recruits from the North Central region came from rural areas than from urban communities. The difference was statistically significant ($x^2=10.3$ and $p=1$ in 1,000, approximately).

Nine hundred twenty-three recruits came from the Southern States; 9 percent had never been vaccinated before. In these States, more of the unvaccinated recruits had lived in rural areas than in urban communities. The difference was statistically significant ($x^2=23.7$ and $p<1{,}000$).

The number of recruits from the Western States was too small to subject to critical analysis.

The distribution of recruits with primary reactions to the current vaccination is shown in table 4.

Eighteen percent of the recruits from the Northeast gave a primary reaction; corresponding figures for the North Central States, the South, and the West were 19 percent, 18 percent, and 14 percent, respectively. There was no significant difference among the four geographic areas in the proportions of recruits

Table 4. Percentage distribution of primary reaction of 2,263 military recruits to current smallpox vaccination, by geographic origin and type of home community

Geographic origin	Total		Type of community					
			Urban		Town		Rural	
	Number examined	Percent primary reactions [1]	Number examined	Percent primary reactions [1]	Number examined	Percent primary reactions [1]	Number examined	Percent primary reactions [1]
Total	2,263	18	798	15	839	19	626	22
Northeast	293	18	189	19	86	20	18	11
North Central	920	19	342	15	348	19	229	25
South	923	18	241	11	356	19	326	23
West	127	14	26	15	48	19	53	9

[1] Percentage based on number of examined recruits in each region.

with a primary reaction to the current vaccination.

Fifteen percent of the urban recruits, 19 percent of the town recruits, and 22 percent of the rural recruits gave a primary reaction to the current vaccination. The difference in percentage of primary reactions in recruits from urban communities and from rural areas was statistically significant ($x^2=14.2$ and $p<1$ in 1,000).

The percentage distribution of primary reactions among the recruits in individual States or groups of States is shown in table 5. The percentages regarded as significant varied from 5 to 27 percent. Factors responsible for the high values are probably multiple.

Table 5. Percentage of primary reactors to smallpox vaccination of 2,259 [1] military recruits, by individual States or groups of States

States or groups of States	Number in study	Percent primary reactors
New England States	72	22
New York and New Jersey	112	12
Pennsylvania	109	21
Maryland, Delaware, Virginia, West Virginia, and District of Columbia	80	20
North and South Carolina	175	5
Georgia and Florida	79	15
Alabama	77	22
Kentucky	90	12
Tennessee	84	25
Ohio	234	27
Michigan	168	13
Indiana	70	23
Illinois	150	17
Wisconsin	58	7
Minnesota	124	18
North and South Dakota	[2] 39	[2] 26
Oklahoma, Kansas, and Iowa	[2] 21	[2] 43
Mississippi, Arkansas, and Louisiana	121	26
Missouri	64	12
Texas	205	22
Arizona and New Mexico	[2] 21	[2] 14
Colorado, Utah, and Nevada	[2] 23	[2] 9
Montana, Idaho, and Wyoming	[2] 23	[2] 23
Washington, Oregon, and California	[2] 60	[2] 13
Total	2, 259	18

[1] For 4 of the original recruits, data on "home State" were not available.

[2] Results probably not representative, because of the small numbers of recruits included.

Twenty years ago, Collins (*3*) found that 65 percent of 2,415 males aged 15–24 years had been vaccinated and 4 percent reported that they had had smallpox. From our survey, it appeared that in 1951 the situation had been improved—approximately 90 percent of a somewhat similar age group of males (17–22 years) had been vaccinated and none reported an attack of the disease.

From our interviews with these military recruits, the impression was gained that fewer young adult males from the Northeastern States (3 percent) had not been vaccinated before entering the armed services than had those from other parts of the country—North Central, 11 percent; South, 9 percent; and West, 12 percent. Nevertheless, similar proportions of primary reactions were obtained from each of these four geographic regions.

When rural and urban communities were compared, it was found that more of the recruits from rural areas gave a primary reaction than did those from urban communities. Assuming that vaccination was performed with equal skill in both rural and urban localities, this difference could be taken merely to reflect the fact that more of the rural recruits than urban recruits had never been vaccinated before entering military service.

Because of the very nature of the population included in this survey, these results should not be taken to indicate the immunity status of the population of the United States as a whole. Nevertheless, it represents the type of survey that it is desirable to conduct from time to time to serve as an index of the general effectiveness with which vaccination against smallpox is being practiced on a regional basis throughout the country.

Summary

This survey concerns the response to vaccination as performed by Armed Forces medical personnel on United States military recruits who were vaccinated and examined at the time of their induction into the services in 1951.

Almost 2,700 male recruits, the majority aged 17–22 years, were interviewed as to their history of previous smallpox vaccination, and their responses to the current smallpox vaccination were recorded.

About 10 percent of this nationwide sample had never been vaccinated before. None reported a previous attack of smallpox. Fewer recruits from the Northeastern States than from

other parts of the country had never been vaccinated before. More recruits from rural areas than from urban communities had never been vaccinated previously.

About 18 percent of 2,263 recruits gave a "primary" reaction to the current vaccination. Of those who had never been vaccinated before, about 85 percent gave a primary reaction. More primary reactions were observed among those who had been vaccinated 10 years ago than among those who had been vaccinated within the last 10 years. However, the difference was not remarkable.

There was no difference in the proportion of primary reactions among recruits from the four geographic regions of the United States.

The percentage of primary reactions among recruits from individual States or groups of States varied from 2 percent to 26 percent.

ACKNOWLEDGMENT

Nine students (now doctors) from the Yale University School of Medicine were responsible for reading the vaccination results: H. M. Goldberg, A. S. Kaplan, A. D. Katz, R. D. King, J. K. Luce, R. B. Schultz, H. M. Sterling, W. A. Taylor, and J. Walker.

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Legal Note—Liability for Pooled Blood Plasma

The New York Court of Claims recently held that the State of New York is not civilly liable for the death of a hospital patient who died from homologous serum hepatitis which he developed as a result of a nonemergency transfusion of pooled unirradiated blood plasma. The plasma had been distributed to the hospital, free of charge, by the State of New York. *Hidy* v. *State of New York*, 137 NYS 2d 334 (Ct. Claims, N. Y., 1955).

The court held that the State was under no duty to affix warning labels to the plasma containers nor to distribute literature concerning the dangers of pooled blood since such information was readily available to practitioners through the professional journals. The Appellate Division of the New York Supreme Court has previously held that the State cannot be held liable for the death of a patient when the contaminated blood plasma is administered under emergency conditions where "safer" types of transfusion material are not available. *Parker* v. *State*, 280 App. Div. 157, 112 NYS 2d 695 (1952), leave to appeal denied 304 NY 989, 109 NE 2d 474.

DDVP . . . The New Insecticide's Present Status

By KENNETH D. QUARTERMAN, B.S., M.P.H.

THE DISCOVERY of dimethyl 2,2-dichlorovinyl phosphate, a new and potent insecticide known as DDVP, was announced February 1, 1955, by the Secretary of Health, Education, and Welfare. The new organic phosphorus compound was developed by chemists on the Savannah, Ga., laboratory staff of the Public Health Service's Communicable Disease Center. Preliminary tests have proved the compound to be about equally as toxic to houseflies as parathion, but only one-fifth to one-tenth as toxic to rats as parathion.

Since the discovery announcement, subsequent publicity unfortunately has, to some extent, overemphasized the presently apparent potentialities of this new insecticide. At the same time, little or no information has been given to the public as to its availability. The Public Health Service has received many inquiries for information on uses, costs, manufacture, and distribution of DDVP.

DDVP is not now being produced commercially and is not available for use by the general public. Before it can be released for general use, much investigation is needed to determine dosage requirements for specific insects, suitable formulations, and the toxicological hazards associated with its usage. Considerable time will be required to develop such information and to register labels with the United States Department of Agriculture as required by the Federal Insecticide, Fungicide, and Rodenticide Act.

Mr. Quarterman, a biologist, is chief of the Technical Development Laboratories, Technology Branch, Communicable Disease Center, Public Health Service, Savannah, Ga.

Invention for Public Use

It has been determined that the Federal Government is entitled to the entire right, title, and interest in the invention of DDVP. It was decided also that the Government should not seek to obtain a domestic patent on the invention because prior publications on the invention by the Government scientists who developed it are deemed sufficient protection against the prosecution of a successful patent application by a later inventor. These publications will, within 1 year from the first date of publication, constitute a dedication of the invention to the public. Such a dedication adequately protects the interests of the Government. On the basis of this determination and decision, any manufacturer who wishes to do so may proceed with the domestic production of DDVP in the United States without seeking a license from the Government.

Manufacture of DDVP

A number of chemical manufacturers have expressed an interest in producing DDVP. How many companies may ultimately engage in its manufacture cannot be determined at this time, and the number undoubtedly will be governed by the demand for the product. At the present time, only one company is known to have a pilot plant in operation. The limited quantities of DDVP being produced are available only to qualified research units for further study and field evaluation against a variety of insects. Until DDVP is produced commercially, estimates concerning its cost are impractical.

Extent of Usefulness

What insects DDVP may prove useful in controlling cannot be predicted accurately. Be-

cause of its chemical properties and the present knowledge of its insecticidal activity and toxicity to warm-blooded animals, it appears that DDVP is apt to find only limited use against insects of public health significance. It has been shown to be effective on DDT-resistant houseflies by topical application (*1*) and in poison baits (*2*). It may be reasonable to expect that DDVP will be useful in such situations as outdoor space sprays to control adult flies and mosquitoes. There also may be some usage for it as a larvicide against flies and mosquitoes. Because of its relatively high volatility, DDVP is not likely to be useful as a residual spray; and because of its toxicity, it appears unsuitable for use in vaporizers in occupied buildings.

DDVP should find wider use in agriculture than in public health. It should be effective against many of the agricultural pests now controlled with parathion and tetraethylpyrophosphate (TEPP). Since DDVP appears to be considerably less toxic than these compounds, and since it will offer less residue problem on food crops than many other insecticides now in use, it is reasonable to anticipate considerable usage of DDVP in agriculture, especially on food crops.

In summary, DDVP is a promising new insecticide, the full potentialities of which remain to be developed by further research, much of which is already in progress. It is not available to the public and is not likely to be before 1956, at the earliest. The Government has dedicated the discovery of DDVP to the public; and any manufacturer may engage in its production in the United States without obtaining a license from the Government. Its sale in this country, of course, will be subject to compliance with the requirements of the Federal Insecticide, Fungicide, and Rodenticide Act as are all other insecticides.

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Epidemiologists' Conference Organized

The Conference of State and Territorial Epidemiologists was organized in Atlanta at the close of the second national meeting of epidemiologists, May 16–18, 1955. The conference was sponsored jointly by the Communicable Disease Center and the National Office of Vital Statistics of the Public Health Service.

Since the first meeting of State epidemiologists in 1951, called by the Public Health Service at the request of the Association of State and Territorial Health Officers, epidemiologists have been active in recommending improvements in the various communicable disease control programs and in Federal and State morbidity reporting systems. Through the conference a broader avenue of approach will be open to them.

The officers for the newly organized conference are: president, Dr. Roy F. Feemster, Massachusetts; president-elect, Dr. A. C. Hollister, Jr., California; vice president, Dr. A. L. Gray, Mississippi; secretary-treasurer, Dr. Samuel B. Osgood, Oregon. Chosen as members of the council were: Dr. Ruth Church, Illinois; Dr. L. L. Parks, Florida; and Dr. Robert F. Korns, New York.

Our Growing Demands for Water

—*What To Do About Them*—

By CARL G. PAULSEN, B.S.C.E.

THE BLEAK RUINS of the cliff dwellings in the southwest and the associated remnants of irrigation ditches built by a people long forgotten suggest that a former civilization of our country was a mortal victim of a shortage of water. Water is also the key resource of our present civilization, and, as population increases and industry expands, we are confronted more and more frequently by the question of what to do about our growing demands for water. Fortunately, we of the present day have the knowledge and mechanical facilities to deal with problems of water supply in ways infinitely better and more effective than those antecedent tenants of our country.

Taken as a whole, the earth has a marvelously efficient water supply system. In a sense the sun acts as a huge pump circulating water in a closed circuit, the hydrologic cycle. As water comes within our reach, we use it as we need it, and after its temporary service, it continues its natural course in the cycle. Notwithstanding the remarkable efficiency of this system, a serious problem of utilization is presented by its lack of uniformity. The quantity and quality of our water supply are variable in time and place. The present extended drought in the south and southwestern States and many of the numerous public water supply shortages experienced throughout the United States during the last few years are evidence of this variability.

The shortages are also aggravated by our ever-increasing requirements for water. Our withdrawal use of water increased fourfold between 1900 and 1950, and it has been estimated that it will double between 1950 and 1975. Modern domestic conveniences have greatly increased our water requirements. Air conditioning, automatic home laundries, and automatic dishwashers were unheard of 50 years ago and were not common even 25 years ago. Many household appliances that are not ordinarily thought of as heavy users of water have greatly increased the electric power consumption, and that, in turn, has increased the water use at the central hydroelectric or steam powerplants.

Advances in technology have added greatly to industrial water requirements, both in quantity and quality. Synthetic fibers, such as rayon and nylon, require much larger quantities of water for processing than the natural materials they replace. Synthetic rubber produc-

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tion requires large quantities of water not needed in production of natural rubber. Each additional stage in oil refining requires additional process water, increasing the quantity required per unit of crude oil considerably above that needed by earlier simple stills.

Large Supply—Unevenly Available

Much has been said and written concerning the nationwide water situation. If we use long-term average runoff as an index, we can estimate our annual available water supply at about 1,300 million acre-feet, as compared with a withdrawal use at present of about 195 million acre-feet. Even regionally the situation is not serious, but in certain local areas it is critical. The total average annual supply in the 17 western States is about 390 million acre-feet, as compared with the present withdrawal use of about 100 million acre-feet. Except for irrigation, only a small part of the water withdrawn for use is consumed; some estimate the amount to be as little as 10 percent. Therefore, the ratio as a whole between supply and demand appears even more favorable if consumptive use, rather than withdrawals, is taken into account.

We can see that nationwide this country is blessed with a plentiful supply of water. However, some areas have a surplus of water all of the time, whereas other areas may have a surplus during some seasons, and still other areas seldom have sufficient water. Differences in water supply are striking. Using the runoff as an index of available supply, the greatest supply at any place in the United States is along the coast of the Pacific northwest, particularly in the Olympic Mountains, where the average annual runoff of Wynoochee River at Oxbow, Wash., would cover its drainage to a depth of about 150 inches. On the other hand, several areas in the southwest have an average annual runoff of less than one-fourth inch, and no streams flow out of the Great Basin.

The variation in daily streamflow may be very great. In some arid or semiarid regions 90 percent of the annual runoff may occur in a single week. On the other hand, some streams have an exceptionally uniform rate of flow. The Loup River and its tributaries draining the Sand Hill region of Nebraska are noted for their uniform flow. The average flow on about 75 percent of the days is within 10 percent of the average annual flow. The Deschutes River, a spring-fed stream in Oregon, is another example of uniformity of flow.

The annual runoff of most streams, however, is highly variable. A stream in which the variability is especially high is the San Gabriel River in California in which, during the 56-year period 1896 to 1951, the annual runoff averaged 116,000 acre-feet but ranged from 10,000 acre-feet in 1899, or less than 9 percent of the average in 1922, to 410,000 acre-feet or 353 percent of the average.

The ready availability of the large quantities of good water required by our modern communities was not a consideration in their original establishment, and, as those communities grow, the problems of water become more and more difficult and costly of solution. Los Angeles is an extreme example of this kind of situation. There, 3 percent of the Nation's population lives in an area that receives only 0.04 percent of the Nation's precipitation and has less than 0.0005 percent of the Nation's streamflow. Consequently, it has been necessary to import large quantities of water great distances at great expense.

This is the broad picture then, the base from which we must proceed: In terms of the entire country, we have a generous supply of fresh water, but it is so unevenly distributed that the supply is more than ample to meet our present requirements in some places and insufficient in others. Our water supply, very large though it may be, is variable in time, place, and quality. We must recognize, therefore, that in many areas there will never be as much water as can be used. Consequently, our concern is to take stock of these variables so that we may undertake such steps as seem feasible to derive more benefit and service from our water resources.

Several possible steps are suggested: It may be possible to develop new sources of supply, as by inducing artificial precipitation and demineralizing saline waters. The present supplies may be developed further by storage, control of pollution, and so forth. Water losses may be

reduced. Existing supplies may be utilized further through more efficient use and by re-use.

Developing New Sources of Supply

The possibility of increasing precipitation by cloud seeding is being explored by several groups, but definite conclusions as to the success of cloud seeding in stabilizing or increasing to a substantial extent water supplies in areas of short supply seem not yet conclusively demonstrated.

The prospect of increasing our fresh water supply by converting saline water to fresh water appears to be promising under certain conditions.

Congress, in 1952, passed Public Law 448, providing for research which may lead to development of practical processes for converting saline water to fresh water. The Saline Water Conversion Program is conducted by the Department of the Interior by coordinating and encouraging research in this field through federally financed grants and contracts.

It is possible that converted saline water can be used economically by some municipalities, especially those in water-short areas of high productive value, if fresh water can be provided at the cost of about $125 an acre-foot, and for irrigation in highly productive areas if fresh water can be supplied at a cost of $40 an acre-foot or less.

One of the processes being investigated—the ion-permeable membrane process—might prove to be an answer to some water needs since its cost is proportional to the dissolved solids content of the raw water. Typical preliminary cost estimates of conversion of fresh water are about $450 an acre-foot for sea water, $40 an acre-foot for saline water from Texas containing about 10,000 p.p.m. of dissolved solids, and $4 an acre-foot for water from South Dakota with a dissolved solids content of about 855 p.p.m.

The present fresh water supplies can, of course, be developed further and in many places quite extensively by the use of additional storage reservoirs and by improving the quality of the water. As our water resources become more highly developed, water quality becomes increasingly important. Poor quality is detrimental to the utility of a supply because it makes the water unsuitable for some use and for certain other uses, such as irrigation, it necessitates the application of larger quantities to prevent an undesirable accumulation of minerals in the soil.

Storage facilities, both surface and underground, enable us to extract more service from our water supply. During the last 7 years the surface reservoir capacities for the Nation have been increasing at an annual rate of more than 16 million acre-feet. In January 1954 there were 1,300 reservoirs in the United States having a usable capacity of more than 5,000 acre-feet. Their combined usable capacity was 278 million acre-feet.

In the 17 western States, the total usable reservoir capacity amounted to 193 million acre-feet of which more than 59 million acre-feet is provided for irrigation. Many additional reservoirs of less than 5,000 acre-feet capacity are used for irrigation. According to the Bureau of the Census, about 5,500 reservoirs having a capacity of less than 1,000 acre-feet were used for irrigation in the 17 western States in 1950.

Although the water stored at any one time in all the rivers and lakes of the Nation is enormous, the volume of fresh water stored in the countless natural openings in the soil and rocks beneath the water table is probably several times greater. The volume of water stored beneath the land surface is dependent primarily upon the physical characteristics of the rocks and the climate. Nevertheless, the continued usefulness of a ground water reservoir ultimately must depend, not on its extent and the quantity of water originally contained but on the conditions affecting both replenishment and transmittal of the water from recharge areas to the point of use.

Surface and subsurface reservoirs have several characteristics in common. Sufficient water must be available to replenish them. Both are refilled during wet periods, so, in order to be of maximum use, water should be withdrawn during dry periods to make room for a new supply. A reservoir which is full all of the time is not serving its primary function. This is a characteristic of subsurface reservoirs that may be overlooked since they are not visible.

A ground water reservoir is similar also to a surface reservoir in that to be useful a supply of water must be available to refill it. The natural recharge rate of some ground water reservoirs may be low, but under favorable conditions artificial recharging can be effected by spreading storm runoff on the recharge area, or by injecting water through recharge wells. Artificial recharge by water spreading is not new; it has been practiced on the cone of the Santa Ana River in California since 1912 and in other places as well.

Improving the Quality of Water

The quality of water in storage can be improved by mixing low flows that are high in dissolved solids with less concentrated flood flows that are wasted, by reducing or preventing undesirable wastes reaching the streams, and by reducing or preventing salt water encroachment both in our streams and in our ground water reservoirs. The chemical and physical quality of surface waters, other than lakes, varies almost continuously. Flood flows are usually less mineralized than dry weather flows. By storing the better quality flood waters and gradually releasing them to mingle with the more mineralized low flow, we can improve the quality of the low flow. Stored water can generally be used more advantageously than natural flow because of its more uniform and better quality.

Surface water storage upstream may improve the quality of water in tidal reaches of a stream. The water in the estuaries of many streams is a mixture of fresh water and sea water. The distance that the saline water flows up the tidal stream depends on the flow of the stream; the lower the flow, the farther upstream the saline water extends. When low flow is increased by storage and release of flood flows, the saline water is flushed toward the mouth of the stream. Although this does not increase the total supply of fresh water, it does make fresh water available along a reach of the stream that would otherwise have been contaminated by salt water.

Abatement of unnecessary pollution would increase the usable supply of water in many areas. For example, brine wastes from oilfield operations in the Arkansas River Basin have increased the dissolved solids in the river water in some places to an undesirable extent, and have also contaminated ground water in some places, either directly from brine-disposal ponds or indirectly by infiltrating contaminated river water.

The usefulness of large quantities of fresh ground water has been destroyed by encroachment of saline water. This occurs where large quantities of fresh water have been pumped from wells and a nearby body of salt water is hydraulically connected to the fresh ground water supply. When the water level in a fresh ground water reservoir is lowered to such an extent that salt water will flow into it, contamination of the fresh water supply will occur, with ruinous results. Salt water encroachment may occur from deep-lying strata through improperly constructed or corroded wells, or, in coastal areas, from the sea. In one place, encroachment from the sea has been halted by inserting a fresh water barrier between the two bodies of water. The barrier is erected by introducing fresh water into a row of recharge wells in large enough quantities to create a hydraulic gradient from the barrier to the salt water.

Sometimes salt water encroachment can be reduced or prevented by a better distribution of wells and by plugging abandoned wells which form the connection between ground water formations. As larger and larger quantities of ground water are developed, especially in coastal areas, the opportunity for encroachment will increase. Therefore, we must be ever watchful to keep salt water encroachment to a minimum. The shortage of water and devices for the control of its quality offer very effective means for further developing available supplies to meet the growing demands.

Practicing Water Conservation

Many millions of acre-feet of water are lost annually by useless evaporation and transpiration. To the extent that these losses can be reduced, the usable supply of water can be increased.

Evaporation from water surfaces is an unavoidable and nonrecoverable loss. In the 17 western States evaporation from reservoirs is

roughly estimated to be about 15 million acre-feet per year. This does not include evaporation from water surfaces of natural streams. Although the evaporation process is unavoidable, the total loss by this cause can be held to a minimum by careful locations of reservoirs and by establishing suitable operating procedures. Climatic factors affecting evaporation often vary widely within a drainage basin. If alternate reservoir sites are available, evaporation losses can be held at a minimum when the site selected is one which has the smallest surface area and climatic conditions that are least favorable for evaporation. Water losses from a system of reservoirs can be reduced by using water from those reservoirs having a high evaporation potential first so that their surface area is appreciably reduced.

The Geological Survey of the Department of Interior in collaboration with several other Federal agencies has completed a research project to test several methods of measuring evaporation reliably from large bodies of water. The results of these tests are now being applied to Lake Mead, Nev.

The Geological Survey is also making a study of the evaporation from Lake Colorado City in Texas. This lake is used as a cooling pond for a large steam powerplant. The object of the study is to determine evaporation from the lake, including the effect of added heat, and to determine the effect of added heat on the thermal structure of the lake. The results of this study will enable us to estimate the extent that ponds may be used for cooling and enable us to decide whether the use of cooling ponds is good conservation practice.

Bodies of ground water, like surface reservoirs, may be subject to large losses. One source of large losses is transpiration by phreatophytes, or water-loving plants, such as salt cedar which have little or no economic value. It has been estimated that salt cedar may transpire as much as 7 acre-feet of water per acre annually. A Geological Survey engineer has estimated that phreatophytes of all kinds now cover about 15 million acres in the 17 western States and may consume in the aggregate as much as 20 to 25 million acre-feet annually, a volume of water equal to about twice the average annual flow of the Colorado River at Lees Ferry, Ariz.

A second source of substantial loss from ground water is evaporation from areas where the water table is only a few feet below the land surface and its overlying capillary fringe extends up to the land surface. Evaporation from such areas is continuous, being sustained by water which rises through the capillary fringe, just as a flame is sustained by capillary rise of fuel in the wick of a kerosene lamp. Evaporation losses from such areas are large. In the Big Smoky Valley of Nevada evapotranspiration losses may be considerably in excess of 100,000 acre-feet a year.

Large losses from shallow ground water bodies by evapotranspiration have an adverse effect on the quality of the remaining water. Plants use only a very small part of the dissolved solid content of the water, and none of the minerals are carried away by the evaporated water. As a result, these dissolved solids become concentrated in the water that remains or are precipitated in the soil, to be redissolved by subsequent rains. Therefore, the reduction of losses in these various ways would not only increase the quantity of water available but would also improve its quality.

Re-use of Waste Water

Use of waste or polluted water, wherever quality requirements will permit, is another way of increasing the effective water supply. The practice of using sewage effluent for irrigation is not new; it has been known for almost 100 years. Treated sewage effluents have been used also as a source of water for industry and for ground water recharge. As an indication of this trend, the Shell Oil Company recently made arrangement to reclaim waste water from the Ventura, Calif., sewage disposal plant at the rate of 2 million gallons a day. Some sewage is not suitable for re-use, especially if the raw water contains a high concentration of dissolved solids, or if the sewage contains undesirable industrial wastes. In general, the domestic use of water will increase the dissolved-solids concentration by an average of 100 to 130 p.p.m.

The University of California Engineering

Department recently estimated that in California there is approximately 1 million acre-feet of waste water available for re-use. The Geological Survey estimated that about 4 million acre-feet of water was used for industrial and domestic use from public supplies in the 17 western States during 1950.

Industry frequently uses its waste water by recirculation. Re-use of water in industry does not reduce the consumptive use of water but greatly reduces the withdrawal use. The water requirements within an industry range widely, indicating a wide range in economy of water use.

Many examples can be cited where re-use of water has tremendously reduced the water intake. Probably the most frequently cited example is the Fontana Plant of the Kaiser Steel Company where the intake per ton of steel is only 1,100 gallons as compared with the industrywide value of 65,000. A steam electric powerplant recently constructed in Texas uses only 1 gallon of water per kilowatt hour output, as compared with 60 to 100 gallons for steam powerplants where the cooling water is not circulated.

The Water Resources Division of the Geological Survey recently made a survey of the water requirements of the pulp and paper industry. On the average, the maximum rate of water use per ton of paper produced was about 5 times the minimum rate in making similar products in the same general area. A similar survey of the water requirements of the carbon black industry shows an even wider range in water use. Process water required to produce a pound of carbon black ranged from 0.79 gallon to 20 gallons by the furnace process and from zero to 0.19 gallon by the contact process.

Much of the industrial water is used for cooling and, therefore, cooling towers and ponds become important where water is re-used. Each recycling of the water through a cooling tower reclaims about 95 percent of the water. The only loss from the system is that small quantity evaporated to accomplish the cooling and a small amount of blowdown to maintain reasonable concentrations of dissolved solids in the recirculated water. The loss from a cooling pond is the evaporation owing to the addition of warmed water plus natural evaporation and seepage. The present rate of installation of cooling towers indicates increased re-use of water. In 1953, the member companies of the Cooling Tower Institute sold 38 installations to private and public steam-electric generating plants having a combined capacity of 1 million gallons a minute.

Many of the industry's water requirements, particularly that for cooling, can be adequately fulfilled by salt water where it is available. To safely use saline water, industrial equipment must be fabricated of material to resist the chemical aggressiveness of the water. The quantity of saline water used is imperfectly known, but we do know that at least 14 million acre-feet is used annually and that the total quantity is probably much larger. If industry could afford to pay the higher installation and maintenance costs, a great deal more saline water could be used.

Stretching the Available Supply

Although over much of the Nation there is plenty of water, the supply is extremely variable, and many communities will at times not have enough to satisfy their growing needs. A major problem then is to derive the maximum benefit and utility from our water resources.

Several courses of action are open by which we can stretch the available supply to satisfy the optimum use:

We can develop our present supplies more intensively by construction of additional reservoirs, development of presently unused ground water reservoirs, and more extensive use of artificial recharge of ground water reservoirs.

We can increase the usable supply by reducing or preventing contamination from saline waters, urban wastes, or industrial wastes, along the lines encouraged by the Public Health Service under the Water Pollution Control Act. Many acre-feet of water are lost annually by unproductive evaporation and transpiration. Reduction of these losses will in effect increase the quantity and improve the quality of our usable water supply. Our water supply will go further if we closely match water quality and water requirements, that is, if we use high qual-

ity water for uses that require high quality water and use water of poorer quality where it can be tolerated. Thus, we may be able to use some sewage effluents and saline waters which are presently wasted. A large quantity of waste water can be salvaged by re-using or re-circulating water in our industrial plants. An acre-foot of water salvaged and re-used is just as effective as an acre-foot of newly developed water. Possibly some additional water can be provided by conversion of saline water to fresh water.

In many parts of the Nation many of the inexpensive sources of water have already been developed. As our water resources become more and more intensively developed, the cost of new developments will continue to increase. At the present time, most of the conservation measures that are mentioned are technically feasible. In some places they are economically feasible. The economic feasibility of these measures will become widespread as competition for water increases.

The solution of our problem requires facts—facts on a local scale involving all the variables of streamflow, storage, and movement of ground water, and the mineral and sediment concentration and temperature characteristics of the water. We have made considerable progress in collecting, compiling, and interpreting data on water resources, but we need to know more, especially more details on the local scale. We need to know more about evaporation and transpiration losses, their magnitude and methods of reducing them. We need to know more about reclaiming waste water and about the water requirements of industry both as to quantity and quality.

Detailed knowledge of our water resources and of their uses is a prime essential to assure the most benefit and utility from our water resources.

Departmental Announcements

Oveta Culp Hobby, Secretary of Health, Education, and Welfare, resigned from her position effective August 1, 1955. Mrs. Hobby was appointed Federal Security Administrator on January 21, 1953, and was made Secretary on April 11, 1953, when the Federal Security Agency became the Department of Health, Education, and Welfare. She resigned the positions of editor and publisher of The Houston Post and executive director of Station KPRC–AM–FM–TV, Houston, Tex., at the time of her appointment.

Mrs. Hobby came to her Cabinet post with a distinguished record of public service. She directed the Women's Army Auxiliary Corps in 1942. In 1943 she was appointed director of the Women's Army Corps with the rank of colonel. She was awarded the Distinguished Service Medal by the United States Government and the Military Merit Medal by the Philippine Government. The author of a textbook on parliamentary law, Mrs. Hobby served for several years as parliamentarian in the Texas House of Representatives. She also served on the board of directors of the American Society of Newspaper Editors.

Marion B. Folsom, Under Secretary of the Treasury since January 1953, has been named by President Eisenhower to succeed Secretary Hobby. Active in Government and private industry social security programs for more than a quarter of a century, Mr. Folsom was a member of President Roosevelt's advisory council which helped draft the original Social Security Act in 1934. In subsequent years, he served on advisory councils which studied operations of the social security system and made recommendations to the Congress. He worked with the Department of Health, Education, and Welfare on the plans which in 1954 resulted in congressional amendments to extend social security coverage and benefits. He also was chairman and a founder of the Committee of Economic Development.

Mr. Folsom was instrumental in the development of the group life insurance program for Federal employees which was put into effect in August 1954. Several years earlier he had helped organize the Group Medical Care Insurance Plan in Rochester, N. Y.

A graduate of the University of Georgia and the Harvard Business School, Mr. Folsom was treasurer and a director of the Eastman Kodak Company from 1914 until January 1953, before he came to the Department of the Treasury.

Technical Report on Poliomyelitis Vaccine

ON June 10, 1955, the Public Health Service sent a Technical Report on the Salk Poliomyelitis Vaccine to the Secretary of Health, Education, and Welfare. Published below are the summary, the report on epidemiological experience and new developments in biologics, and an expanded calendar of events. Copies of the report were made available to all State and local health departments. Since only a limited number of copies are available through the Public Health Service, it is recommended that interested health department employees obtain a copy in their own agency.

Summary

The report presents the technical problems involved in the production, testing, and safety of Salk poliomyelitis vaccine. It also describes the responsibilities of the Public Health Service in control of the manufacture of the vaccine as a biological product.

The vaccine as prepared for the 1954 field trial was an experimental product made by commercial producers for the National Foundation for Infantile Paralysis. After some initial difficulty, the industrial firms were able to turn out a good product, and the field trial was carried out successfully. Vaccine production for the field trial permitted the laboratories of industry and the Public Health Service to acquire experience in testing.

As a result of its studies over a period of 2 years, which included participation with industry and with Dr. Jonas Salk in testing of vaccine for the field trial, the Public Health Service planned to act quickly on licensing if the analysis of the field trial data showed that the vaccine was safe and effective. It had issued prospective minimum requirements in May 1954, as advisory for pharmaceutical laboratories which might wish to manufacture and store vaccine intended for commercial use pending decision to license the product. When the success of the field trial was reported April 12, 1955, official minimum requirements were issued. Six manufacturers, each of which had produced vaccine under the provisional requirements, were granted licenses.

Records and samples of vaccine lots had been submitted to the Public Health Service Laboratory of Biologics Control prior to April 12, and, within the next few days, those which were considered acceptable were released. Most biological products for commercial distribution are released on the basis of an examination of the detailed record of events in manufacture and testing (known as a protocol), with or without further testing by the Laboratory of Biologics Control. Release of most of the lots of poliomyelitis vaccine was based on review of the manufacturing protocols. Tissue culture tests for the presence of live virus were completed prior to release by the Laboratory of Biologics Control on about half of these lots and monkey tests were completed on 6 lots involving at least 1 lot from each of 5 manufacturers.

On April 26, six cases of poliomyelitis were reported among children who had received vaccine manufactured by the Cutter Laboratories. At the request of the Public Health Service, this firm immediately recalled all of its vaccine. The ensuing investigation of the Cutter Laboratories was later extended to the entire industry and led to a temporary suspension of the nationwide vaccination program.

The Public Health Service on April 28 established a Poliomyelitis Surveillance Unit within its Communicable Disease Center in Atlanta, Ga. This unit is investigating all reported cases of poliomyelitis, whether or not asso-

ciated with vaccine. Sixteen virus laboratories, throughout the Nation, are cooperating in examining and reporting upon specimens collected from cases and suspected cases. The epidemiological data so far obtained clearly define the Cutter incident as an outbreak with characteristics of a common source epidemic. The cases of poliomyelitis following use of vaccines made by the other manufacturers have not been more numerous than would be expected at this season except for a few cases which suggested (but were too few to be conclusive) an association with one lot of vaccine produced by Wyeth Laboratories. That firm has withdrawn the unused portion of this lot.

The Salk vaccine is a suspension of poliomyelitis virus inactivated by formaldehyde to make the virus harmless but still capable of inducing the production of antibodies. The vaccine contains inactivated virus of each of the three types. The original concept of vaccine preparation was that the process itself assured a wide margin of safety. Safety tests for the vaccine were conceived to detect both mass contamination resulting from accidents in manufacture and residual live virus which the process was intended to eliminate.

The intensive investigations of the past 5 weeks indicate that the records manufacturers were required to submit did not include certain data which are essential for an adequate assessment of consistency in performance. The protocols submitted related only to lots of vaccine proposed for clearance and gave no information concerning lots discarded in the course of manufacture. Further, the information requested did not bring out certain data on processing and testing now known to be important.

The total experience of the manufacturers now reveals that the process of inactivation did not always follow the predicted course, since positive tissue culture tests not infrequently occurred after the expected completion of the inactivation process. Greater dependence, therefore, must be placed on sensitive tests for very small quantities of residual live virus as part of process control.

Two types of tests are used to determine the presence or absence of live virus in the vaccine: the monkey test and the tissue culture test. The tissue culture test has been found to be more sensitive than the monkey test. It must be performed with a large enough sample of vaccine and under closely controlled conditions if it is to have the maximum value. The theoretical considerations which govern inactivation and testing have been analyzed in the light of information developed during this inquiry.

As a result of the inquiry and of analysis of the manufacturers' experience and records, changes were made in processing control and safety testing. Revised requirements in the testing procedures were established, and the release of vaccine was resumed. The modifications provide greater assurance of safety. As a result of the review and the institution of revised requirements, the production and availability of vaccine has been delayed.

The Salk vaccine applies new practices in the production of viral vaccines. The vaccine has progressed from the experimental level to large-scale production with unprecedented rapidity. This speed, reflecting the increased tempo of all medical research, created problems in biologics control amenable to solution only with the accumulation of knowledge and experience. It is likely that other problems of equal complexity will be raised by the development of other new viral vaccines. Action taken by the Public Health Service for dealing with both the current and the long-range problems include:

1. Amendment of minimum requirements for the production and testing of poliomyelitis vaccine.
2. Incorporation of minimum requirements in official regulations as mandatory standards.
3. Creation of a Technical Committee on Poliomyelitis Vaccine.
4. Creation of a Division of Biologics Standards, with strengthened staff and facilities.
5. Increased onsite plant surveillance and consultation.
6. Reoriented testing and research program.
7. Establishment of a Poliomyelitis Surveillance Unit.
8. Review of legislative authority.

Epidemiological Experience

Investigation of reports of paralytic poliomyelitis occurring in association with injections of vaccine was assigned to the Communicable

Disease Center. The newly established Poliomyelitis Surveillance Unit has operated to yield precise field information on the occurrence of poliomyelitis throughout the country. As a result of this activity the Cutter incident was clearly defined as an outbreak with characteristics of a common source epidemic.

Poliomyelitis Surveillance Program

The Public Health Service conducts a surveillance program through its Communicable Disease Center to help the States in rapid recognition, study, and control of such diseases as malaria, typhus, smallpox, diphtheria, psittacosis, and rabies. In 1954, CDC personnel collaborated in the poliomyelitis field trial evaluation, under the direction of Dr. Thomas Francis.

The Public Health Service had prepared, with State health departments and cooperating laboratories, to extend surveillance over poliomyelitis this season. This surveillance was highly desirable to study the durability of immunity in the half a million children who had been immunized during the field trials in 1954, and even more desirable if the results of the field trial led to a general immunization program in 1955.

When the first occurrence of poliomyelitis cases in vaccinated children was reported, this program was quickly brought into play to collect and evaluate field and laboratory data which might indicate the nature and significance of the disease outbreak. Although some cases of poliomyelitis could be expected to occur by coincidence following vaccination, each reported case deserved thorough investigation.

On April 25, 1955, the Public Health Service received a report of poliomyelitis in a Chicago

Poliomyelitis Vaccine Distribution

Plans for the voluntary control and distribution of poliomyelitis vaccine this autumn rest at present on two conditions:

1. The completion of the program of the National Foundation for Infantile Paralysis to provide vaccine for first and second grade school children. When this occurs, an agreed-upon system of voluntary controls will go into effect. Vaccine will be shipped into each State by the manufacturers under a plan that will assure equitable distribution among the States, and which will take into account the desires of States as between public vaccination programs and distribution in normal drug channels.

2. The assumption that the vaccine will still be in short supply. If this condition prevails, it will demand strenuous efforts to assure that available supplies are distributed equitably among the States and among children in the priority age group in all parts of the States.

Statement by Otis L. Anderson, Assistant Surgeon General, and chief, Bureau of State Services.

The Public Health Service responsibilities for allocating vaccine equitably among the States are described in this chart.

For instance, under Step 1, the National Advisory Committee on Poliomyelitis Vaccine recommended that vaccine initially be given to children of 5 through 9. As increased supplies of vaccine become available, additional age groups will be included. In Step 2, a State's share of this child population will determine its share of vaccine. Thus, if a State has 2 percent of the Nation's population of children in the priority group, it will be entitled to 2 percent of the available supply of vaccine.

The other steps describe the procedures developed to assure a proper division of vaccine, as determined by each State authority between public agencies and private distribution outlets. Public agencies include local health departments, State clinics, public hospitals, and any other facilities whose services are provided through tax funds; private channels of distribution include drug stores, physicians, and privately operated hospitals, etc. The proportion of immunizations provided by public agencies in each State will vary, depending on how much vaccine the State decides to purchase, plus the amount, if any, purchased by other funds.

Once the Public Health Service has advised the State of the amount of vaccine available to it, and has advised the manufacturers of the State's allocations to public agencies (Steps 3 through 7), the task of assuring fair distribution within the State will be borne by the State authority.

The key to intrastate distribution is the quality of planning in the State itself. Through regional meetings and individual consultation the Public Health Service has worked with all States and Territories in devising the basic elements of intrastate plans. Obviously, no single plan can be devised that would fit the needs and resources of all States. The Executive Committee of the State and Territorial Health Officers' Association collaborated with the Public Health Service in the development of suggested princi-

child who became paralyzed approximately one week after injection of vaccine manufactured by the Cutter Laboratories.

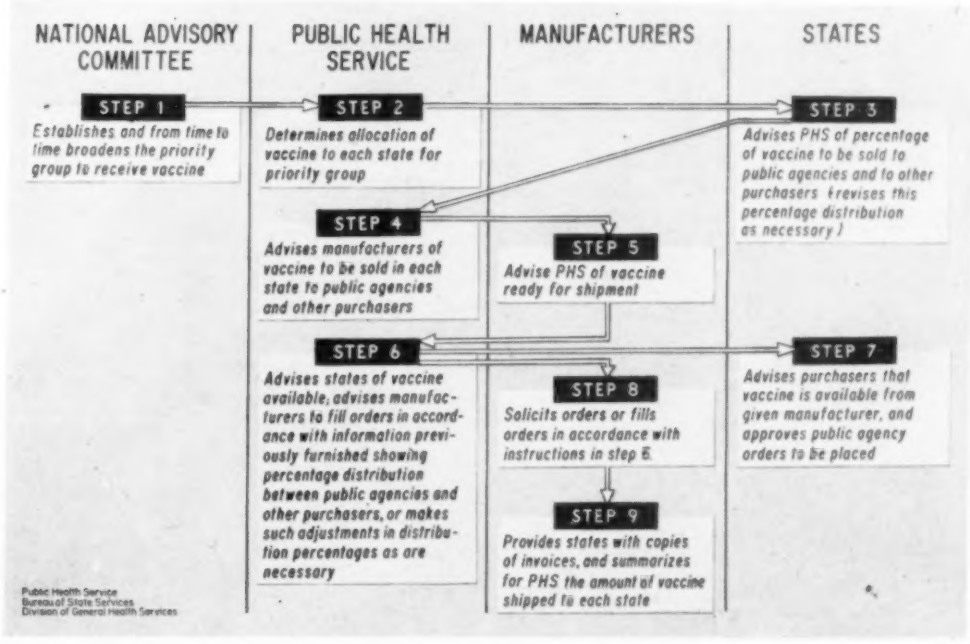
On April 26, at noon, illness suspected to be poliomyelitis was reported from the Napa Valley, Calif., in a child who also had received Cutter vaccine about one week previously. On the evening of April 26, four other cases of illness following injection of Cutter vaccine were reported from widely separated areas in California. California State health authorities immediately started investigation of the cases.

The absence of other known poliomyelitis in some of these areas at the time, the interval between vaccination and onset of the disease, and correlation between site of injection and site of paralysis created sufficient presumptive evidence of association with the vaccine to cause the Public Health Service to take action.

On April 27, the Surgeon General requested the Cutter Laboratories to recall all of its product pending a complete investigation. On April 28 he directed that the surveillance program be expanded to aid in evaluation, by epidemiological observations, of the occurrence of poliomyelitis in relation to vaccination. The data presented here are derived from reports of the Poliomyelitis Surveillance Unit through May 27, 1955, and constitute the field data which the Public Health Service has considered in determining actions since April 26.

Poliomyelitis Associated With Vaccination

A total of 113 poliomyelitis cases, with 5 deaths, were recognized among nearly 5½ million individuals within one month after injection of poliomyelitis vaccine (table 1). The greatest number of cases associated with the


NATIONAL ADVISORY COMMITTEE
PUBLIC HEALTH SERVICE
MANUFACTURERS
STATES
STEP 1
Establishes and from time to time broadens the priority group to receive vaccine
STEP 2
Determines allocation of vaccine to each state for priority group
STEP 3
Advises PHS of percentage of vaccine to be sold to public agencies and to other purchasers (revises this percentage distribution as necessary)
STEP 4
Advises manufacturers of vaccine to be sold in each state to public agencies and other purchasers
STEP 5
Advise PHS of vaccine ready for shipment
STEP 6
Advises states of vaccine available; advises manufacturers to fill orders in accordance with information previously furnished showing percentage distribution between public agencies and other purchasers, or makes such adjustments in distribution percentages as are necessary
STEP 7
Advises purchasers that vaccine is available from given manufacturer, and approves public agency orders to be placed
STEP 8
Solicits orders or fills orders in accordance with instructions in step 6
STEP 9
Provides states with copies of invoices, and summarizes for PHS the amount of vaccine shipped to each state
Public Health Service
Bureau of State Services
Division of General Health Services

ples of intrastate distribution. Included in this material are the following suggested objectives:

1. Equitable distribution of vaccine to eligible persons—the priority age group—in all areas throughout the State.

2. Public acceptance of the vaccine and the distribution plan.

3. Acceptance of and adherence to program principles by physicians, local health officers, pharmacists, and other related professional groups. (Accurate records and either a plan for screening orders in advance or a "post-audit" system will be necessary to assure equitable distribution, and to prevent the piling up of stocks in some areas and consequent deprivation in others.)

The manufacturers have cooperated fully in setting up their part of the voluntary control system. The public health profession has the job of planning its corollary organization and of making the whole system function.

Table 1. Poliomyelitis cases and attack rates in recipients of poliomyelitis vaccine, with onsets between Apr. 20 and May 21, 1955

Vaccine manufacturer	Approximate number of vaccinees (total)	Cases			Total attack rates per 100,000 per month [1]
		Paralytic	Nonparalytic	Total	
Total	5, 394, 000	78	35	113	2
Cutter	409, 000	59	10	69	17
Lilly	2, 514, 000	10	19	29	1
Parke Davis	1, 234, 000	2	0	2	<1
Pitman-Moore	461, 000	0	2	2	<1
Wyeth	776, 000	7	1	11	1

[1] These attack rates are of limited significance in themselves, since vaccines of some manufacturers were used in areas in which the seasonal rise in incidence already had begun.

product of any one manufacturer was 69—59 of them paralytic. These cases occurred among approximately 409,000 recipients of vaccine prepared by the Cutter Laboratories. The attack rate in this group was 17 per 100,000 in 1 month.

Most of these cases were reported from California and Idaho where the National Foundation for Infantile Paralysis provided Cutter vaccine for school clinics, but a scattering of cases occurred in other parts of the country where the vaccine had been released in small quantities through commercial channels. Cutter vaccine was used for school clinics in Arizona and New Mexico; but no cases have been reported among vaccinated children from these States.

Among approximately 4,985,000 persons who received the products of four other manufacturers, a total of 44 cases was reported, only 19 of which were paralytic. The attack rate in this group was less than 1 per 100,000 in 1 month. The nonparalytic cases are of epidemiological significance but of little clinical or social importance. The reporting of nonparalytic poliomyelitis depends upon diagnostic practices, which vary from place to place; 12 of the 25 nonparalytic cases were reported from Texas. Since, however, official weekly morbidity reports from States do not always distinguish between paralytic and nonparalytic cases, the latter are included in this analysis in order to compute "expected" cases by comparison with 5-year trends based on State reports.

Cases associated with vaccine produced by other manufacturers include: 19 paralytic and 10 nonparalytic Lilly-associated cases, largely from southern States; 7 paralytic and 4 nonparalytic Wyeth-associated cases from the midwest and east; 2 paralytic Parke Davis-associated cases from Illinois; and 2 nonparalytic Pitman-Moore-associated cases from Nebraska.

Type 1 poliomyelitis virus has been isolated from 17 Cutter-associated and 2 Wyeth-associated cases. One isolation of type 2 and one isolation of type 3 virus have been made from two separate Lilly-associated cases.

Cases Reported and Number Expected

It was only among first and second grade children who received vaccine that age is known with sufficient accuracy to calculate expected numbers of cases. It is not possible to compare the vaccinated group with a nonvaccinated group in the same areas because a very high proportion of the children of this age received vaccine. The method used in computing ex-

Table 2. Comparison of reported and expected numbers of poliomyelitis cases in children receiving poliomyelitis vaccine in National Foundation for Infantile Paralysis clinics, Apr. 15–May 7, 1955

Vaccine manufacturer	Approximate number of vaccinees (NFIP clinics only)	Poliomyelitis cases, with onset from Apr. 20–May 21	
		Reported number [1]	Expected number [2]
Total	4, 844, 000	79	36
Cutter	309, 000	35	5
Lilly	2, 514, 000	29	24
Parke Davis	834, 000	2	3
Pitman-Moore	411, 000	2	2
Wyeth	776, 000	11	2

[1] Reported cases aged 6–8 years with onset between Apr. 20 and May 21. Includes both paralytic and nonparalytic cases since expected numbers for comparison are based on crude rates which include all cases reported as poliomyelitis in previous years.

[2] Expected cases if the estimated, age-adjusted, median attack rate for the previous 5 years had pertained in the vaccinees of 1955.

NOTE: These rates are specific for geographic areas where the various poliomyelitis vaccines were used.

pected cases has been to apply the median attack rate for the past 5 years in each geographic area to the number of children who were vaccinated. This is a crude measure, since poliomyelitis incidence undergoes wide and unpredictable variation in successive years, but it provides the best available tool to determine whether cases among children vaccinated are more common than would be expected by coincidence (table 2).

The difference between the numbers observed and expected (35 and 5) is significant in the case of those receiving Cutter vaccine and demonstrates an association between the Cutter product and an increased poliomyelitis incidence. The excess of reported cases over the expected number vaccinated with the Wyeth product (11 and 2) may be significant, but the numbers are too small to permit firm interpretation of such crude data.

Among the children who received vaccines made by Lilly, Parke Davis, and Pitman-Moore, the numbers of cases reported are within the range expected by chance occurrence.

Evidence of Infectious Virus in Vaccine

Evidence supports the hypothesis that the excess cases among individuals receiving Cutter vaccine may have resulted from the use of vaccine containing infectious virus. This evidence falls into three categories:

1. The interval between injection of vaccine and first paralysis in Cutter-associated cases ranged from 5 to 20 days (table 3). The median case occurred on the ninth day and the spread of the mid three-quarters was from 6 to 14 days. This finding parallels the frequency distribution of incubation periods in monkeys infected by intramuscular injection of virus. Moreover, the temporal distribution of cases following injection of Cutter vaccine is the expected distribution in a common source outbreak resulting from a single exposure to the infectious agent.

Additional significance attaches to these findings when comparison of the intervals between inoculation and first paralysis is made specific for geographic area and calendar time. Large numbers of children received Cutter vaccine in clinics in California and Idaho, the California clinics being held slightly before those in Idaho.

Table 3. Paralytic poliomyelitis cases by interval between poliomyelitis vaccine inoculation and onset of paralysis, Apr. 20–May 21, 1955

Interval (days)	Paralytic poliomyelitis cases in vaccinees inoculated with material produced by—				Experimental data on monkeys [1]
	Cutter	Lilly	Parke Davis	Wyeth	
Total [2]	50	9	1	6	32
5–7	8	2	0	0	3
8–10	22	4	0	1	12
11–13	8	0	0	1	9
14–16	9	1	1	0	3
17–19	2	1	0	1	3
20–22	1	1	0	1	1
23–25	0	0	0	2	1

[1] Data abstracted from David Bodian: Viremia in experimental poliomyelitis. Am. J. Hyg. 60:358, November 1954. Mahoney virus was injected into the right calf of 32 cynomolgus macaques and the interval between inoculation and paralysis recorded.
[2] Data not available on interval for 9 Cutter cases and 1 each of Lilly, Parke Davis, and Wyeth.

Yet, the distributions of cases following vaccination in these two areas show marked similarity when adjusted for time differences.

2. Cutter-associated cases show a high degree of correlation between the extremity injected with vaccine and the extremity which was first paralyzed; 43 of 55 cases (78 percent) on whom records are complete showed this relationship (table 4). This finding is strikingly similar to the experimental experience in monkeys.

In contrast to this high degree of correlation for Cutter-associated cases, only 1 of 10 Lilly-associated cases showed this relationship.

Paralytic cases associated with Wyeth and Parke Davis vaccine, although consistent with this observation on correlation, are too few to warrant conclusion.

3. A number of poliomyelitis cases have occurred among household associates of vaccinated children (table 5). A total of 47 such cases (39 paralytic and 8 nonparalytic) had been recognized by May 27. These were distributed about equally between parents and children. Of the 47 cases among household associates, 35 (29 paralytic and 6 nonparalytic) were associated with Cutter-vaccinated children; 9 (7 paralytic and 2 nonparalytic) were associated with

Table 4. Comparison of paralytic poliomyelitis cases in vaccinees by site of inoculation and site of first paralysis

Sites of inoculation and first paralysis	Paralytic poliomyelitis cases in vaccinees inoculated with material produced by—						Experimental data on monkeys [1]	
	Cutter		Lilly		Parke Davis	Wyeth	Number	Percent
	Number	Percent	Number	Percent	Number	Number		
Total [2]	55	100	10	100	2	7	32	100
Same	43	78	1	10	1	3	23	72
Different	12	22	9	90	1	4	9	28

[1] Bodian, D. Unpublished data from experiment cited in table 3.
[2] Data not available on site of first paralysis for 4 Cutter and 1 Lilly cases.

Wyeth-vaccinated children; and 3 (all paralytic) were associated with Lilly-vaccinated children. About one-third of the vaccinated children in these households had developed a minor illness within 2 weeks after inoculation and prior to the onset of poliomyelitis in the household contacts.

The interval between vaccination of children and the onset of poliomyelitis in their parents and siblings approximates two incubation periods in the 35 Cutter-associated and the 9 Wyeth-associated cases, as would be expected if the vaccinated child were the source of infection. The 3 Lilly-associated cases followed shorter intervals.

Table 5. Poliomyelitis cases in household contacts of vaccinees with onset between Apr. 22 and May 27, 1955

Cases in household contacts of vaccinees and onset interval	Vaccinees inoculated with material manufactured by—			
	Cutter	Lilly	Wyeth	Total
Total cases	35	3	9	47
Paralytic	29	3	7	39
Nonparalytic	6	0	2	8
Span in days between inoculation of vaccinee and onset in parent or sibling	[1] 9–33	8–14	17–30	8–33
Median days	19	9	19	19

[1] Excludes 1 case where interval was 2 days.

Evidence Against Provocation

Another hypothesis considered in the investigation of cases of paralytic poliomyelitis in children following injection of vaccine was that central nervous system involvement may have been precipitated by the intramuscular injection of vaccine in individuals who were already infected with poliomyelitis virus. Had this been the case, the excess cases would be expected to occur in areas known to be experiencing some poliomyelitis. One might have expected naturally occurring cases at this season in the southern States and in southern California. The excess cases did not adhere to this pattern but occurred unexpectedly in Idaho in association with Cutter vaccine where no other poliomyelitis was being observed. They failed to occur in the southern States where a very large number of children received Lilly vaccine in areas where poliomyelitis was known to be present. These data do not support the provocation hypothesis.

Results of Epidemiological Survey

A total of 113 poliomyelitis cases (78 paralytic and 35 nonparalytic) had developed by May 21 among more than 5 million individuals vaccinated against poliomyelitis since April 14, 1955. Comparison of reported and expected numbers of cases indicate association between Cutter poliomyelitis vaccine and an increased incidence of poliomyelitis. The distribution of Cutter-associated cases by interval between inoculation and date of paralysis and the correla-

tion between sites of inoculation and paralysis are strikingly similar to experimental data. These findings indicate that at least some of the Cutter-associated cases developed from use of poliomyelitis vaccine containing infective virus. Additional data relating cases to specific lots of vaccine are under analysis in connection with the study of the Cutter plant processes, and will be included in a report to be made when all phases of this study are completed.

Evidence is not conclusive but suggests there may have been a similar association with a few cases following the use of Wyeth vaccine. In contrast, the data indicate that the incidence of poliomyelitis after use of the products of other manufacturers was probably coincidental.

New Developments

A number of aspects of the production and testing of the Salk poliomyelitis vaccine are unique. During the vaccine's development, field trial, and initial use, many problems arose, to which precedents and experience could not be applied. The progress of the vaccine to practical usability involved the National Foundation for Infantile Paralysis, local and State health officers, practicing physicians, university research laboratories, the pharmaceutical industry, and the Public Health Service. All these took part in arriving at major decisions, many of which established new precedents.

Progress in medical science is not always an uninterrupted forward motion. Throughout the history of medicine and public health, most great advances have been made step by step, with each new and unforseen obstacle overcome, usually slowly, as it has been encountered. This has always involved a certain amount of acceptance of risk, trial and error, discovery of new knowledge, application of this knowledge in production and clinical use, and resumption of forward movement.

The development of the Salk vaccine is an example of this process in action at a very rapid rate. Events have been telescoped in time so that the vaccine has been developed, tested, and used in a matter of months instead of years. Procedures which appeared sound and adequate several months ago on the basis of experience up to that time have had to be modified in the light of scientific and technical data now available.

The increase in scientific knowledge from this experience has been considerable. The Public Health Service is in a position to use the experience of recent months, superimposed upon experience of past years, as a basis for extending and improving its biologics control functions.

The Public Health Service's new measures are discussed below:

Amendment of Minimum Requirements

The minimum requirements for vaccine production and testing have been revised to provide a substantially greater margin of safety. Essentially, these changes provide for a required uniformity of sampling, which should provide a more uniform sensitivity of the test, and application of more tests at two critical points in the manufacturing process. One of these is a tissue culture test for virus, using samples of final container material to exclude contamination incidental to breaks in manufacturing routine subsequent to clearance of the trivalent pool. These and other less formal changes incidental to the recent review of the total manufacturing process will reduce still further the possibility that tested and released vaccine could contain sufficient active virus to be harmful to man.

In using any preventive or therapeutic substance, some risk always exists. This risk must be negligible in comparison with the hazard of a disease like poliomyelitis. Although the Salk vaccine has generally shown a remarkable degree of safety, the amended requirements still further reduce the risk involved in its use.

Incorporation as Mandatory Standards

The amended requirements for poliomyelitis vaccine will be incorporated in official regulations to establish their status as mandatory standards. In the past, these minimum requirements served only as guides which, however, have been fully accepted and applied.

Creation of a Technical Committee

The Surgeon General on May 25, 1955, created a standing expert advisory committee on poliomyelitis vaccine. The members of this committee are Drs. David Bodian, Thomas Francis, Jr., Jonas Salk, Richard Shope, and

Joseph Smadel, with Dr. James A. Shannon, associate director of the National Institutes of Health, as chairman. The committee was made responsible for: (*a*) formulating recommendations on measures to assure improved safeguards and greater effectiveness of the Salk vaccine, (*b*) recommending release of lots of vaccine, and (*c*) fostering collaborative research by industry, the National Institutes of Health, and university scientists on problems which must be solved in connection with vaccination against poliomyelitis.

Creation of a Division of Biologics Standards

The Public Health Service biologics control program has operated heretofore as a constituent laboratory within one of the large research programs of the National Institutes of Health—the National Microbiological Institute. Now the Surgeon General has requested authority to organize expanded biologics function, with the status of a separate division in the National Institutes of Health, to be called the Division of Biologics Standards. The Secretary of Health, Education, and Welfare has approved this request.

This step is taken as the culmination of developments in medical research related to: (*a*) the expanding range of diseases to which biological products may be applicable, (*b*) the kinds of new biologics which may be available, particularly in the field of virology, and (*c*) the compressed time interval between the discovery of new biologics and their use.

The principles utilized in the control of virus infections successfully applied to the Salk vaccine offer promise of solutions to a hitherto baffling group of disease problems. The so-called "wonder drugs"—antibiotics and sulfa compounds—have made little impression on the problems of virus infection. We can expect the development of potent new biologics which will have unprecedented application, particularly to control of virus diseases.

The fact that new products are developed, tested, and used over progressively shorter time periods is one of the boons of modern medical research. But it creates an essentially new set of tasks in the field of biologics control. The new tasks can be performed more effectively under the new arrangement.

The change also removes the biologics control activity from a framework in which emphasis has been on research not primarily related to biologics control. As a separate division, the staff will have both a clearer mandate and a better opportunity to conduct such research as is essential to deal with trends, advances, and problems in biologics.

The professional staff of the new division will be augmented. Broader professional coverage will be provided by the addition of senior members to the staff. The division will also be strengthened by additional facilities and by augmented administrative and statistical services.

Onsite Plant Surveillance and Consultation

Public Health Service staff members and expert part-time consultants drawn largely from university research centers will conduct a program of surveillance and technical consultation in the plants of the manufacturers while vaccine is under production. These scientists will collect information for the division and will foster collaborative work deemed essential by the Technical Committee on Poliomyelitis Vaccine. Similar procedures will be followed as other problems of biologics control arise in the future.

Expanded Testing and Research Program

The testing program of the new division will be directed primarily toward determination of the exact significance of safety and potency tests, and modification of tests and their interpretation to make test data yield more penetrating information.

When an industrial product must meet highly precise standards, whether the product be a jet engine or a biologic, primary dependence is placed on "tests in process" rather than tests of the final product. A final test must be made, but it is in no sense a substitute for the many tests conducted along the way.

Great emphasis will not be placed on simple repetition of the testing already done in industrial laboratories since this adds little to the safety factor. The mechanism of onsite plant consultation, described above, will determine that such testing is well done, and will interpret critically the test results.

The development and interpretation of these tests is of paramount importance in controlling safety and potency. Much remains to be learned about their underlying significance. These questions, for example, are not now answerable: How long must a tissue culture be watched before definitive readings can be taken? What is the effect of calf serum on virus growth in tissue culture? How can the monkey safety test be made more sensitive? Resolution of questions of this sort is better calculated to insure the safety of virus vaccine than are any number of repetitive tests. Working toward their solution will be a major responsibility of the new division.

Poliomyelitis Surveillance Unit

The Public Health Service has established a nationwide network for supplying precise and current information on poliomyelitis cases, and for obtaining from collaborating university laboratories effective laboratory support for epidemiological studies. The purpose is to study vaccine performance.

Review of Legislative Authority

The Biologics Control Act was passed in 1902, and amendments since then have not fundamentally altered the basic act. The terms of the act are being carefully reviewed in the light of the increasing complexity and scope of the biologics control function. If amendments appear advisable, recommendations will be made to the Congress. In this connection, it is to be emphasized that industrial cooperation, particularly in the course of the recent review of the processes of the six manufacturers, has been excellent.

Calendar of Vaccine Standards and Distribution

July 1953. In preparation for the expected clinical trial of the poliomyelitis vaccine developed by Dr. Jonas Salk under the auspices of the National Foundation for Infantile Paralysis, Dr. William G. Workman, chief of the Public Health Service Laboratory of Biologics Control, visited the Connaught Laboratories in Toronto, Canada, to discuss and observe techniques for growing bulk poliomyelitis virus.

December 1953. Dr. Joseph Smadel, Army Medical Services Graduate School, and Dr. Workman consulted with the National Foundation for Infantile Paralysis in the preparation of provisional standards for the manufacture of poliomyelitis vaccine. These standards, derived largely from the experience of Dr. Salk in making an experimental vaccine in his own laboratories, were designed as a guide for industry in the preparation of vaccine for the field trial.

February 1954. The provisional standards were sent by the National Foundation for Infantile Paralysis to 10 manufacturers with demonstrated competence and experience in the production of biological products, inviting them to make poliomyelitis vaccine for the field trial. Two of these (Parke Davis and Lilly) had been in experimental production since the fall of 1953, working collaboratively with Dr. Salk. Five manufacturers responded, Parke Davis, Eli Lilly, Cutter, Wyeth, and Pitman-Moore. (Later, Sharp and Dohme elected to enter the field, making a total of six manufacturers.) The vaccine they were to produce was experimental, on contract to the National Foundation for Infantile Paralysis, and to be used only for investigative purposes.

February 1954. The Laboratory of Biologics Control had agreed in late 1953 to cooperate in testing the vaccine, at the request of the National Foundation. In February 1954, it began participation in triplicate safety testing of the experimental vaccine, receiving large numbers of test samples. This triplicate testing was done to gain experience in safety testing and to take advantage of the opportunity to further developmental research on a biological product. The National Foundation agreed that no vaccine would be used in the field trial until polyvalent pool material, taken prior to division and final bottling, had been tested for safety in the manufacturer's laboratory, Dr. Salk's laboratory, and the Laboratory of Biologics Control and after approval by the Vaccine Advisory Committee of the National Foundation for Infantile Paralysis.

March 1954. At the request of the National Institutes of Health, a series of meetings was held with National Foundation representatives, Dr. Salk, the Vaccine Advisory Committee, and the manufacturers. Two out of the first 6 lots of experimental vaccine tested in the Laboratory of Biologics Control had failed in safety tests, and an additional 2 had failed the manufacturer's tests, indicating the presence of active poliomyelitis virus in the vaccine. The Vaccine Advisory Committee resolved to delay the initiation of the field trials for 4 weeks to permit a review of the vaccine tested during the extra time and to enable Dr. Salk to complete inoculation studies on some 7,500 children in the Pittsburgh area who were given commercially produced vaccine.

April 1954. The Vaccine Advisory Committee of the NFIP reconvened in Washington. Representatives of the National Institutes of Health and the manufacturers were present. The data on the vaccines produced and tested since the March meeting (10 batches in number) were considered, together with Dr. Salk's data concerning the 7,500 inoculated children. All results were of a negative character, and the committee recommended that the field trial proceed. The statement issued following the meeting, which was concurred in by the Public Health Service, contained the following statement: ". . . the possibility of infectious activity remaining in any vaccine meeting the specifications and minimal requirements has been reduced to a point below which it cannot be measured by practicable laboratory procedure."

May 1954. The field trial was begun, using vaccine supplied by Parke Davis and Eli Lilly. Three other manufacturers (Cutter, Wyeth, and Pitman-Moore) produced lots of material which passed the tests, but the National Foundation's decision was to use the vaccine from the two largest producers only in order to reduce variability from multiple manufacturers. The Public Health Service officially indicated a belief in the sound judgment of the Vaccine Advisory Committee in its recommendation to the NFIP to conduct the field trial.

May 1954. A document entitled "Minimum Requirements, Poliomyelitis Vaccine" was prepared by the Laboratory of Biologics Control with the advice and cooperation of the manufacturers and Dr. Salk. This was distributed to vaccine manufacturers and interested parties as a guide to prospective standards if the product were later to be licensed.

July 1954. The inoculation phase of the field trial was completed. The results, which were not available until April 12, 1955, indicated that there was no evidence of disproportionate frequency of paralytic poliomyelitis in vaccinated children up to 4 weeks after injection, nor of selective localization of paralysis.

August 1954. The National Foundation for Infantile Paralysis contracted with Dr. Thomas Francis, Jr., University of Michigan School of Public Health, for analysis of the data derived from the field trial. It was understood that his results could not be expected before March or April 1955. The Public Health Service provided about 20 epidemiologists and statisticians to assist Dr. Francis with his study.

August 1954. The National Foundation placed orders with the five manufacturers for the purchase of up to 27 million cc. of vaccine. This was done to encourage the manufacturers to stay in production after the field trial.

September 1954. Beginning in this month, and continuing through to January 1955, the Laboratory of Biologics Control inspected the plants of each of the six vaccine manufacturers except for one that had been inspected in July (Wyeth). These were general inspections required by regulations and included attention to poliomyelitis vaccine production plans and facilities.

November 1954. Two meetings, attended by representatives of the National Foundation, the manufacturers (including Sharp and Dohme, which had now entered the field), NIH staff, and representatives of the Connaught Laboratories in Toronto, Canada, were held in Pittsburgh to discuss deterioration of potency in some lots of vaccine. This was learned through tests made on vaccine left over from the NFIP field trial, and it was believed to be caused by merthiolate which was used as a preservative in the vaccine. This problem was then intensively studied by all concerned, with a view to preventing the deleterious effect of merthiolate or selecting another preservative which did not have this action. The manufacturers had to discard several millions of doses of vaccine containing merthiolate, produced by that time.

December 1954. The Laboratory of Biologics Control advised the manufacturers, the National Foundation, and Dr. Salk that, before licensing, it would require additional clinical data on vaccine prepared without merthiolate since it was technically a different product from the one used in the field trial. Data supplied on 6,000 children injected with nonmerthiolated vaccine indicated that the vaccine without merthiolate was safe and potent. (An additional 3,000 were reported injected by Dr. Salk, but no data were submitted to the Laboratory of Biologics Control).

January 1955. The manufacturers began to submit to the Laboratory of Biologics Control protocols and samples of their first production lots of vaccine in anticipation of a favorable report on the results of the field trials. The Laboratory of Biologics Control began review of protocols and testing of materials well in advance of the expected date of actual licensing and of the official establishment of minimum standards for potency in order that vaccine might be available for the summer of 1955, should field trial results be favorable.

April 1955. By April 12, 1955, a total of 40 protocols with samples had been submitted to the Laboratory of Biologics Control. Six regular production lots had been fully tested in monkeys and in tissue culture by the Laboratory of Biologics Control with negative results. Additional tissue culture tests had been run on some other lots. Sterility tests were run on all lots. Protocols on all lots were reviewed independently by two or more Laboratory of Biologics Control scientists to determine conformity with the minimum requirements.

April 5, 1955. The director of the National Institutes of Health and the chief of the Laboratory of Biologics Control visited Dr. Francis in Ann Arbor, Mich., to discuss any preliminary data from the analysis of the field trial which would have a bearing upon the minimum requirements and licensing. The immediate need was for data permitting establishment of criteria for acceptable potency levels for poliomyelitis vaccine, some lots of which had already been submitted for release. This information from Dr. Francis was sup-

plemented by personal communications with Dr. Salk.

April 7, 1955. New draft requirements for potency standards were transmitted to the manufacturers.

April 12, 1955. At Ann Arbor, Mich., Dr. Francis announced the results of the analysis of field trials carried out in 1954 under the auspices of the National Foundation.

April 12, 1955. The Laboratory of Biologics Control issued the first official minimum requirements for poliomyelitis vaccine, revising the provisional minimum requirements issued in May 1954 to include standards for potency and a requirement that the manufacturer show that any preservative added to the finished vaccine causes no appreciable loss of potency within the period during which the vaccine may be used.

April 12, 1955. A group of special consultants met with the chief of the Laboratory of Biologics Control in Ann Arbor, to review the report of Dr. Francis and the minimum requirements and to make recommendations as to the licensing of Salk poliomyelitis vaccine. They agreed unanimously that the evidence available warranted licensing of the vaccine.

April 12, 1955. The Secretary of Health, Education, and Welfare issued to six companies (Parke Davis, Eli Lilly, Wyeth, Cutter, Pitman-Moore, and Sharpe and Dohme) licenses to manufacture poliomyelitis vaccine. The Secretary took this action on the recommendation of the chief of the Laboratory of Biologics Control, transmitted through and approved by the Surgeon General of the Public Health Service.

April 12–13, 1955. The first lots of poliomyelitis vaccine were released by the Laboratory of Biologics Control after having met the new minimum requirements. Thirteen lots of vaccine (6 Cutter, 2 Eli Lilly, 3 Parke Davis, and 2 Pitman-Moore) were approved. This rapid action was possible because the protocols and samples had been received in advance.

April 27, 1955. By this date, 40 lots of vaccine containing a total of 10.5 million cc. had been released. (This represents volume prior to final bottling. There is 15- to 20-percent shrinkage in filling due to overfilling and other causes.) Of this total, nearly 5 million cc. were used in first injections (approximately 4½ million under the National Foundation program and one-half million by others with vaccine distributed through commercial channels).

April 26, 1955. The Laboratory of Biologics Control received word of five cases of paralytic poliomyelitis in California among children who had received Cutter vaccine. There had been one earlier case in Chicago within the previous 24 hours. The incidence seemed to be above the rate expected from natural infection, and there was correlation between the site of injection and the paralysis.

April 27, 1955. Following advice from the National Institutes of Health staff, who held a telephone conference with a group of advisers, the Surgeon General requested Cutter to withdraw its vaccine from use. The Cutter Laboratories agreed to do so, and within less than an hour notified all their distributors to recover all of their unused vaccine.

April 27, 1955. The National Institutes of Health sent two experts in virology and in the operation of biologics production plants to make an examination of the Cutter Laboratories and report on all details of their laboratory processing and testing. A sanitary engineer assisted in some of the later phases of the inspection. This team was also directed to check the recovery of all unused Cutter vaccine.

April 28, 1955. The Public Health Service set up a special Poliomyelitis Surveillance Unit in the Communicable Disease Center, Atlanta, Ga., for rapid investigation of all cases reported as poliomyelitis. A nationwide epidemiological network was established through State and local health officials. This was supplemented by cooperating laboratories for recovery, identification, and typing of viruses. The Poliomyelitis Surveillance Unit was directed to make daily reports to the Surgeon General and State health and other medical officials.

April 28, 1955. The Laboratory of Biologics Control (later augmented by 16 cooperating laboratories) began a series of tests on all Cutter vaccine, seeking to determine whether active virus could be detected. Meanwhile, testing of vaccine from other manufacturers continued.

April 29–30, 1955. An ad hoc group of advisers, 11 of the Nation's outstanding virologists and immunologists, was convened at the National Institutes of Health to review the situation and make recommendations on necessary action. By this time, there were 17 reported cases of paralytic poliomyelitis among children injected with vaccine from the Cutter Laboratories. The group reviewed protocols submitted on Cutter vaccine, discussed the situation with senior technical representatives from each of the six vaccine manufacturers, and submitted a unanimous report. The most important findings were that: (*a*) the action of the Public Health Service in recalling the Cutter vaccine was justified; (*b*) the continuation of vaccinations with the product of other manufacturers was warranted; (*c*) careful epidemiological and laboratory studies should be continued and extended; (*d*) it was probable that methods of production and testing could be improved; and (*e*) a small committee of experts should study the minimum requirements to determine if changes were indicated.

April 30, 1955. Based on the recommendations listed above, the chief of the Laboratory of Biologics Control concluded that he could not approve any additional lots of vaccine until the review of the minimum requirements could be completed, and so advised the manufacturers. At this time, action was being withheld on a total of 3.9 million cc. of vaccine for which samples and protocols had been submitted but about which additional information had been requested by the Laboratory of Biologics Control, and on 330,000 cc. sub-

mitted for clearance a day before the meeting on requirements.

May 5–6, 1955. A six-member subcommittee of the April 29–30 ad hoc advisory group was convened at the National Institutes of Health to consider the adequacy of the minimum requirements, including the precise method of vaccine production and testing, the basis for decisions reached by review of protocols, and related matters. Technical representatives of all six vaccine manufacturers attended part of the meeting; they provided detailed data on their total manufacturing experience, including lots of material on which protocols had never been submitted for approval because of failure to meet requirements during processing. The subcommittee: (*a*) noted the accumulating epidemiological evidence of significant association between Cutter vaccine and the occurrence of paralytic poliomyelitis and the absence of evidence implicating poliomyelitis vaccine produced by the other manufacturers; (*b*) stated the desirability of increasing the margin of safety in the vaccine (they prepared a tentative draft for revision of the minimum requirements); and (*c*) believed it might be well to withhold further injections until a team of scientists could visit each plant and study the production processes, facilities, records, and protocols in the light of what was now known about the experience of the various manufacturers.

May 7, 1955. The Surgeon General recommended to the medical and public health professions that vaccinations should be suspended pending completion of study of the recommendations.

May 8, 1955. In a detailed statement, the Surgeon General repeated his recommendation that new vaccinations should not be given for the time being and announced that the manufacturers' production and testing procedures and facilities would be inspected by a team of scientists on a plant-by-plant basis, in the order of their entry into the poliomyelitis vaccine production field.

May 13, 1955. Based on the recommendations of the inspection team at Parke Davis, followed by a careful analysis of their protocols at the National Institutes of Health, approximately 4½ million cc. of Parke Davis vaccine already released were recleared. Of this supply approximately 1 million cc. remained unused. Clearance on one lot previously approved, but as yet unused, was withheld.

May 15, 1955. A scientific review panel meeting at the National Institutes of Health, hearing the report of the plant inspection and reappraising the protocols on Eli Lilly vaccine, cleared approximately 3½ million cc. of Lilly vaccine previously released; of this, only about 378,000 cc. remained unused. The Parke Davis lot on which reclearance was withheld on May 13 was ordered withdrawn, and an additional Parke Davis lot was released. The group also suggested modifications of the manufacturing and testing processes of all manufacturers seeking to build in additional factors of safety.

May 15, 1955. An ad hoc group of epidemiological advisers met at the National Institutes of Health simultaneously with the group on revisions of the minimum requirements. At that time at least 54 cases of paralytic poliomyelitis appeared to be associated with the Cutter vaccine. The group felt: (*a*) that there might possibly be some correlation in a few children receiving the product of another manufacturer; and (*b*) that the number of sibling or parental contact cases following vaccination of a member of the household warranted careful and continuing check.

May 16, 1955. The director of the National Institutes of Health reported to the Surgeon General that two manufacturers, after a long period of producing consecutive lots of vaccine that met all requirements, had recently experienced difficulty getting consistent results. Under the proposed revisions of the minimum requirements, which were under consideration, some of these lots of vaccine could not be approved. These manufacturers were withholding request for clearance of a large amount of vaccine pending a clarification of this problem. This forecast production delays which would require revision in the expected vaccine supply in the immediate future.

May 16–20, 1955. A Public Health Service team of scientists and advisers visited the Wyeth and Pitman-Moore plants. Although the manufacturing techniques and professional competence of the firms were excellent, it was concluded that no action would be taken on reclearance of their vaccine until there could be an opportunity to assess all the data from all the plants and reach conclusions on the factors that should govern release of vaccine already processed as well as steps that might be built into the manufacturing and testing processes as additional safeguards in the future.

May 20, 1955. A special advisory group met at the National Institutes of Health to consider questions of dosage and use of vaccine during epidemics. The dosage question was considered because of some experimental evidence suggesting that injecting 0.1 cc. of vaccine intradermally instead of 1 cc. intramuscularly might be effective. The group, after reviewing all the data, recommended the following: (*a*) adherence to the existing dosage and route of injection, based on evidence of the vaccine's protective value during the 1954 field trials; (*b*) approval of extension of time between first and second dosage of vaccine to 5–6 weeks if necessary; and (*c*) caution concerning use of injections during or near epidemic periods or in areas of high prevalence, with decisions made by local authorities.

May 23, 1955. Members of the Vaccine Advisory Committee of the National Foundation for Infantile Paralysis, the American Medical Association, and the Association of State and Territorial Health Officers met at the National Institutes of Health and were given a review of the poliomyelitis immunization and vaccine situation.

May 25, 1955. An amendment to the minimum requirements was decided upon and discussed in detail with the vaccine manufacturers' technical representatives, who were also given summary information on the current epidemiological picture, the data derived from the five plant inspections, and the analysis of the sensitivity and reliability of the safety tests as performed under the existing minimum requirements. The executives of the manufacturing firms were asked to study the revised standards further and be prepared to bring their technical staff chiefs to a meeting the following day for final discussions.

May 26, 1955. A new, permanent advisory group was established by the Surgeon General and held its first meeting at the National Institutes of Health. Called the Technical Committee on Poliomyelitis Vaccine, this group was asked to perform two functions: to advise on the release of vaccine under the minimum requirements as amended, and to give continuing guidance in vaccine production and testing with particular emphasis on research leading to improvements and refinements in the vaccine.

May 27, 1955. The representatives of all six firms declared their individual support of the amended requirements in the interest of making a safer vaccine, and the Surgeon General made public announcement of this fact. Industry was asked to provide the Public Health Service with revised estimates predicting the amount of vaccine they might be able to make available this summer under the amended requirements.

May 27, 1955. In a press conference at the National Institutes of Health, Public Health Service officials made public the details of the amendments to the minimum requirements and their possible implications in regard to availability of vaccine. It was stated that there would be a net slowdown immediately; that the revisions did not entail any consequential lengthening of the total manufacturing process, once placed in use in each plant; and that small amounts of vaccine would probably be made available beginning early in the week of May 30 and progressively thereafter.

June 1, 1955. The reclearance of 200,000 cc. of vaccine manufactured by Pitman-Moore and by Wyeth was announced. Surgeon General Scheele also stated that "no important differences were found in the quality of performance or the scientific caliber of the manufacturers now releasing the vaccine for general use."

June 9, 1955. A new Division of Biologic Standards was established at the National Institutes of Health. The biologics control program heretofore was the responsibility of a laboratory of the National Microbiological Institute.

Increasingly complex problems in the biologics field, among them the virus vaccines, made establishment of the new organization necessary, Dr. Scheele stated.

June 10, 1955. A detailed technical report [parts of which are published in this issue—Ed. note] was presented by Surgeon General Scheele to Secretary Hobby and made public.

June 22, 1955. The following recommendations on vaccine distribution were made by the National Advisory Committee on Poliomyelitis Vaccine (under the chairmanship of Dr. Chester S. Keefer, special assistant to Secretary Hobby):

(1) When the available supply of vaccine warrants changes in the designated age group to whom immunization is limited, such adjustments will be made by extending the existing priority group so that it becomes increasingly broader; (2) For the time being, the 5 through 9 priority age group should be adhered to. As vaccine becomes available, the committee will broaden the age group to include equal additions below and above this group to the extent that production of the vaccine indicates; (3) Since success of the voluntary plan depends largely upon the development of effective intrastate plans, States should take immediate action to develop and implement plans to assure equitable distribution within their respective populations; (4) In order to insure equitable distribution, plans for intrastate distribution of the vaccine should include a system for obtaining reports of shipments from the manufacturers and reports of sales from retail outlets; (5) A coordinated nationwide educational campaign should be developed to assist health departments and physicians in keeping the public informed about the poliomyelitis vaccine program.

July 8, 1955. The Public Health Service announced the release of 300,000 cc. of Wyeth vaccine, making a total of about 1,837,000 cc. made available since the revision of testing requirements on May 26. Since April 12, the total released was approximately 10,837,000 cc. The Division of Biologic Standards assigned 6 scientists to the plants of the 6 manufacturers to serve as technical aides on production and testing procedures, and in research development.

July 8, 1955. Surgeon General Scheele announced the formulation of a tentative program for developmental research aimed at discovering new knowledge immediately applicable to further improvement of production and testing of poliomyelitis vaccine. The program will consider other strains of poliomyelitis virus for inclusion in the vaccine, improved tests for potency, the improvement of monkey safety tests, the development of concentration methods for use both in safety testing and in routine production processes, and studies on standardization of tissue culture susceptibility to poliomyelitis virus. The research plans call for a positive, cooperative endeavor, in which university, industrial, and government laboratories combine to concentrate their research resources. This program is expected to gear in with programs supported by the National Foundation for Infantile Paralysis and other organizations sponsoring similar and related research.

Functional Distribution of Working Time in a State Health Department

By EDWARD M. COHART, M.D., and WILLIAM R. WILLARD, M.D.

TO SUPPLEMENT the data obtained in a time study in five county health departments in Maryland (*1*), the Yale Public Health Personnel Research Project conducted a similar study in the Maryland State Department of Health. The time study in the State health department, as in the county units, sought to measure the allocation of working time to each of 21 functional categories of activity, using a technique developed by the project (*2*). Time studies were considered an essential part of the Yale project, which attempted to learn what public health workers actually do on the job in the belief that such information is a necessary prerequisite to any recommendations concerning recruitment, training, or utilizaton of personnel.

Participating in the study in the State health department were 137 professional and semiprofessional workers, 88 percent of those meeting the standards set by the project (*3*). They were classified according to service, which is usually but not always synonymous with professional affiliation, as follows: medical service, 12; nursing service, 10; sanitation service, 29; laboratory service, 40; secretarial service, 24; and other services, 22. Time logs were kept for 2 days each month from September 1952 through January 1953, the days of the week and the weeks of the month being staggered so that the data would be representative of the 5-month period. Information as to place in the administrative hierarchy, educational background, and salary was obtained from each worker through interviews.

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The Working Day

The average daily elapsed time on the job, on the basis of a 5-day week, was 8 hours and 22 minutes. Sixty-two minutes of this time were employed in personal activities, such as sick leave, meals, coffee hours, and rest periods, leaving an effective working day of 7 hours and 20 minutes.

The average working day for physicians, nurses, and sanitation workers was approximately 1 hour longer than that for statistics, secretarial, and laboratory personnel. There was an 80-minute spread in the length of the working day in accordance with administrative level of the workers: Program directors had the longest working day; supervisors and staff-level personnel, the shortest.

For all personnel included in the study, the working time was apportioned among four major groups of activity as follows: 30 percent

to technical activities (usually direct service activities requiring professional or technical training); 37 percent to ancillary activities (essential but usually routine, stereotyped activities for which training can be acquired on the job or in a short training course); 21 percent to administration (program planning, management, giving and receiving supervision and education or training); and 11 percent to community relations and organization (activities with other agencies, public information and education, and giving professional education). A detailed analysis of the time spent in these activities in relation to service affiliation, administrative level, level of education, amount of public health training, and salary is presented below and in the accompanying tables.

Technical Activities

Sanitation personnel devoted more time than other workers to technical activities (table 1). More than 50 percent of the sanitation workers' time was spent in these activities, as compared with about 40 percent of the laboratory workers' time and less than 25 percent of the nurses' and physicians' time. Only 3 percent of the time of the secretarial personnel was spent in technical activities.

Staff-level personnel devoted almost twice as

Table 1. Percentage of working time devoted to each of 20 activity categories, by service, in the Maryland State Department of Health

Activity category	Service						
	Medical	Nursing	Sanitation	Laboratory	Secretarial	Other	All
Technical activities	18.6	23.3	51.5	39.4	2.6	25.1	30.2
Ancillary activities	13.0	13.8	16.3	47.7	80.4	31.4	37.3
Administration	34.3	49.5	17.6	10.0	8.9	31.7	20.9
Program planning within health department	13.1	6.5	5.0	3.0	.7	2.0	4.1
Giving supervision and training	6.2	30.4	3.8	4.3	3.5	12.8	8.0
Giving personnel supervision	4.6	4.8	2.8	2.2	3.2	7.4	3.8
Planning and giving individual inservice training	.7	18.2	.8	2.0	.1	3.0	2.8
Planning and giving group inservice training	.9	7.4	.2	.1	.2	2.4	1.4
Receiving supervision, education, and training	7.3	10.3	7.5	1.5	2.9	5.7	5.1
Supervision	.1	.4	1.5	.1	2.0	1.1	.9
Education and training	7.4	9.9	6.0	1.4	.9	4.6	4.2
Management	7.5	2.3	1.3	1.2	1.8	11.2	3.7
Personnel	2.4	1.8	.3	.6	.7	2.7	1.2
Financial	3.7	.3	.4	.1	.3	5.8	1.5
General services	1.4	.2	.6	.5	.8	2.7	1.0
Community relations and organization	33.6	13.1	13.4	2.3	6.6	10.0	10.6
Activities with other agencies	20.1	9.0	5.8	1.0	2.3	6.2	5.6
Joint program planning	7.5	5.2	2.9	.1	1.0	3.3	2.5
Activities with other agencies, except health departments	9.1	2.0	2.1	.9	1.1	1.6	2.2
Activities with other health departments	3.5	1.8	.8	0	.2	1.3	.9
Public information and education	4.1	1.2	7.0	.8	4.3	3.1	3.5
Information services	2.3	.6	6.6	.8	4.0	1.5	2.9
Planning mass media	.8	.3	0	0	.3	1.0	.3
Talks to public	.4	.2	.3	0	0	.6	.2
Group organization	.6	.1	.1	0	0	0	.1
Giving professional education	9.4	2.9	.6	.5	0	.7	1.5
Social activities	.4	.3	1.0	.3	1.6	1.7	.9

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Table 2. Percentage of working time devoted to each of 20 activity categories, by administrative level, in the Maryland State Department of Health

Activity category	High-echelon personnel						Staff-level personnel		
	Health officer	Program director and assistant program director	Administrative assistant	Consultant	Supervisor	All high-echelon personnel	Senior staff	Junior staff	All staff-level personnel
Technical activities	8.0	20.5	4.7	18.7	24.8	19.7	34.3	36.2	35.9
Ancillary activities	16.7	13.4	56.7	16.6	53.8	21.6	40.1	46.7	45.7
Administration	34.7	41.2	16.1	47.6	15.2	37.7	20.5	10.1	11.6
Program planning within health department	18.1	8.7	1.0	8.6	.2	7.3	6.1	1.7	2.4
Giving supervision and training	0	11.7	8.7	32.2	12.5	15.8	9.2	2.8	3.7
Giving personnel supervision	0	6.6	5.5	5.6	6.9	6.3	3.1	2.3	2.4
Planning and giving individual inservice training	0	1.7	3.2	19.2	5.0	5.9	5.8	.3	1.1
Planning and giving group inservice training	0	3.4	0	7.4	.6	3.6	.3	.2	.2
Receiving supervision, education, and training	0	9.5	.6	5.5	1.1	6.9	3.2	4.2	4.1
Supervision	0	.9	.3	0	.6	.6	1.4	1.0	1.1
Education and training	0	8.6	.3	5.5	.5	6.3	1.8	3.2	3.0
Management	16.6	11.3	5.8	1.3	1.4	7.7	2.0	1.4	1.4
Personnel	6.5	3.9	2.9	1.2	1.4	3.0	.5	.2	.2
Financial	10.1	5.3	2.9	0	0	3.5	.2	.5	.4
General services	0	2.1	0	.1	0	1.2	1.3	.8	.8
Community relations and organization	40.5	24.2	21.0	16.3	2.8	19.9	4.6	6.0	5.7
Activities with other agencies	26.1	16.2	6.6	10.3	1.1	12.7	2.5	1.8	1.8
Joint program planning	16.7	7.7	2.2	4.7	1.1	6.1	0	.7	.6
Activities with other agencies, except health departments	2.9	6.3	2.6	3.8	0	4.7	2.5	.6	.8
Activities with other health departments	6.5	2.2	1.8	1.8	0	1.9	0	.5	.4
Public information and education	13.0	3.5	15.4	1.5	.6	3.4	1.5	4.0	3.6
Information services	2.9	1.7	15.4	.6	0	1.9	1.3	3.8	3.4
Planning mass media	9.4	.6	0	.6	.6	.7	.2	.1	.1
Talks to public	0	.8	0	.2	0	.5	0	.1	.1
Group organization	.7	.4	0	.1	0	.3	0	0	0
Giving professional education	1.4	4.5	0	4.5	1.1	3.8	.6	.2	.3
Social activities	0	.6	.2	.9	3.2	1.0	.5	1.0	.9

much time as high-echelon personnel to technical activities (table 2).

Workers who had a bachelor's degree tended to devote somewhat more time to technical activities than those without a degree (table 3), but workers with either a graduate degree or undergraduate training in public health devoted less time to these activities than did those who had not had such training (table 4).

Salary was not directly associated with time spent in technical activities (table 5).

Ancillary Activities

Laboratory workers devoted appreciably more time to ancillary activities than did any other professional workers (table 1). They spent almost 50 percent of their time in these activities,

whereas the medical, nursing, and sanitation workers were similarly engaged only 13 to 16 percent of the time. Secretarial personnel spent 80 percent of their time in ancillary activities.

Almost 50 percent of the time of staff-level personnel and slightly more than 20 percent of the time of workers in the high administrative echelons was absorbed by ancillary activities (table 2). Among high-echelon personnel, supervisors appeared to be particularly burdened with these tasks.

About 60 percent of the time of workers without a college degree and 16 percent of the time of those with a college degree was spent in performing ancillary activities (table 3). An essentially similar relationship existed with respect to public health training (table 4).

Salary increased as participation in ancillary activities decreased (table 5).

Administration

The 21 percent of the time of all personnel spent in performing administrative duties was apportioned among the four major categories as follows: 4 percent to intramural program planning, another 4 percent to management, 8 percent to giving supervision and inservice training, and 5 percent to receiving supervision, education, and training. As previously reported (*1*), the personnel in the five county health departments in Maryland spent 17 percent of their time in administration, the difference stemming from less participation in management and giving supervision and training.

Medical personnel, who devoted 34 percent of their time to administration, greatly exceeded the average (table 1). However, nurses spent even more time than medical personnel in administration, since half of their time was devoted to such activities. This extensive participation by nurses in administration was mainly a reflection of the fact that they devoted 25 percent of their time to giving individual and group inservice training, a percentage which was 12 times as large as that for the laboratory personnel and which exceeded that for the medical and sanitation personnel to an even greater extent. The percentage of time devoted to administration by the sanitation personnel was slightly below the average, while the laboratory and secretarial personnel spent about half the average percentage of time in these pursuits.

The most extensive participation in both program planning and management occurred in the

Table 3. Percentage of working time spent in each of 20 activity categories, by level of education, in the Maryland State Department of Health

Activity category	Less than bachelor's degree	Bachelor's degree	Graduate degree
Technical activities	23. 4	41. 1	33. 0
Ancillary activities	60. 5	15. 8	17. 5
Administration	8. 7	32. 6	30. 7
Program planning within health department	1. 3	4. 6	7. 9
Giving supervision and training	3. 4	14. 6	10. 2
Giving personnel supervision	2. 7	3. 2	5. 8
Planning and giving individual inservice training	. 6	9. 6	1. 5
Planning and giving group inservice training	1. 1	1. 8	2. 9
Receiving supervision, education, and training	2. 5	6. 8	7. 8
Supervision	1. 2	. 7	. 7
Education and training	1. 3	6. 1	7. 1
Management	1. 5	6. 6	4. 8
Personnel	. 5	1. 4	2. 1
Financial	. 4	3. 5	1. 7
General services	. 6	1. 7	1. 0
Community relations and organization	6. 4	9. 1	17. 9
Activities with other agencies	1. 5	6. 1	11. 3
Joint program planning	. 9	2. 9	4. 7
Activities with other agencies, except health departments	. 5	2. 6	4. 3
Activities with other health departments	. 1	. 6	2. 3
Public information and education	4. 9	1. 4	3. 0
Information services	4. 7	1. 4	1. 2
Planning mass media	. 2	0	. 7
Talks to public	0	0	. 8
Group organization	0	0	. 3
Giving professional education	0	1. 6	3. 6
Social activities	1. 0	1. 2	. 6

medical service, followed by the nursing, sanitation, and laboratory services, in that order. The percentage of time devoted to receiving supervision, education, and training was in excess of the average in the nursing, medical, and sanitation services and below the average for laboratory and secretarial workers.

High-echelon personnel devoted almost four times as much time to administration as did staff-level personnel (table 2). This ratio prevailed, in general, for the several categories of administration; it was highest for giving supervision and training and lowest for receiving supervision, education, and training.

Time devoted to administration was positively associated with level of education and with formal public health training. Workers with a bachelor's degree or a graduate degree devoted more than three times as much time as those without a college education to administration, with somewhat similar ratios prevailing for each of its major categories (table 3). Similarly, personnel with a graduate degree or undergraduate training in public health devoted 3 to 4 times as much time to administration as those without formal public health training (table 4). The somewhat higher percentage for personnel with undergraduate public health training than for those with a graduate degree in public health results from the fact that the former devoted a greater proportion of their time to giving supervision and inservice training. Graduates in public health, on the other hand, spent much more of their time in program planning and in personnel, financial, and general services management.

Workers in the highest salary bracket devoted more time than those in any other bracket to administration as a whole and to each of its major categories, with the exception of giving supervision and inservice training (table 5). In this category, personnel in the second highest salary bracket spent the most time.

Community Relations and Organization

Of the 11 percent of the time devoted to community relations and organization, 6 percent was spent in activities with other agencies; 4 percent, in public information and education; and 2 percent, in professional education.

Table 4. Percentage of working time spent in each of 20 activity categories, by level of public health training, in the Maryland State Department of Health

Activity category	No formal public health training	Undergraduate education	Graduate degree
Technical activities	31. 8	14. 1	18. 9
Ancillary activities	39. 9	5. 6	19. 6
Administration	17. 3	68. 9	42. 9
Program planning within health department	3. 2	8. 0	14. 0
Giving supervision and training	5. 7	52. 4	16. 0
Giving personnel supervision	3. 5	. 3	9. 1
Planning and giving individual inservice training	1. 4	43. 1	2. 2
Planning and giving group inservice training	. 8	9. 0	4. 7
Receiving supervision, education, and training	5. 0	7. 5	5. 7
Supervision	1. 0	1. 1	. 1
Education and training	4. 0	6. 4	5. 6
Management	3. 4	. 9	7. 2
Personnel	. 9	. 8	4. 3
Financial	1. 5	0	1. 6
General services	1. 0	. 1	1. 3
Community relations and organization	10. 1	11. 2	17. 0
Activities with other agencies	5. 0	8. 4	12. 4
Joint program planning	2. 1	4. 6	6. 5
Activities with other agencies, except health departments	2. 1	1. 9	3. 6
Activities with other health departments	. 8	1. 9	2. 3
Public information and education	3. 6	1. 7	3. 2
Information services	3. 0	1. 3	1. 4
Planning mass media	. 3	. 4	. 8
Talks to public	. 2	0	. 6
Group organization	. 1	0	. 4
Giving professional education	1. 5	1. 1	1. 4
Social activities	1. 0	. 3	. 7

Medical personnel were engaged in community relations and organization one-third of the time (table 1). They devoted 20 percent of their time to activities with other agencies and

Table 5. Percentage of working time spent in each of 20 activity categories, by annual salary level, in the Maryland State Department of Health

Activity category	$2,000–$2,999	$3,000–$3,999	$4,000–$5,999	$6,000 and over
Technical activities	23. 6	36. 9	34. 6	23. 1
Ancillary activities	71. 2	46. 0	15. 8	16. 5
Administration	3. 4	11. 4	31. 7	39. 4
Program planning within health department	0	. 7	7. 5	9. 5
Giving supervision and training	. 6	5. 3	15. 9	9. 3
Giving personnel supervision	. 6	4. 0	3. 3	7. 0
Planning and giving individual inservice training	0	. 6	9. 6	. 5
Planning and giving group inservice training	0	. 7	3. 0	1. 8
Receiving supervision, education, and training	1. 8	3. 3	6. 0	9. 2
Supervision	1. 0	1. 1	. 8	. 5
Education and training	. 8	2. 2	5. 2	8. 7
Management	1. 0	2. 1	2. 3	11. 4
Personnel	. 2	. 5	. 9	3. 4
Financial	. 6	. 3	. 5	6. 5
General services	. 2	1. 3	. 9	1. 5
Community relations and organization	1. 3	4. 1	16. 8	20. 2
Activities with other agencies	. 5	1. 5	7. 7	14. 2
Joint program planning	. 1	. 9	2. 4	7. 7
Activities with other agencies, except health departments	. 4	. 5	3. 9	4. 5
Activities with other health departments	0	. 1	1. 4	2. 0
Public information and education	. 8	2. 4	7. 3	3. 0
Information services	. 7	2. 2	6. 3	1. 9
Planning mass media	. 1	. 2	. 4	. 6
Talks to public	0	0	. 5	. 3
Group organization	0	0	. 1	. 2
Giving professional education	0	. 2	1. 8	3. 0
Social activities	. 3	1. 3	1. 2	. 6

10 percent to giving professional education. Nursing and sanitation personnel devoted about 13 percent of their time to community relations and organization, the nurses concentrating on activities with other agencies and the sanitation personnel, on public information and education. A relatively minute percentage of the time of laboratory personnel was devoted to community relations and organization. Secretarial personnel spent 7 percent of their time in these activities, more than half of it in public information.

High-echelon personnel spent four times as much time as staff-level workers in community relations and organization (table 2). The time spent by each of these two groups in public information and education was approximately the same, but the former spent considerably more time in activities with other agencies and in professional education.

Participation in community relations and organization increased with level of education and extent of public health training (table 3 and 4). The exception to this general finding was the relatively small percentage of time that workers with a bachelor's degree and those who had received undergraduate public health training devoted to public information and education.

Salary level was also positively associated with the extent of participation in community relations and organization (table 5). This held true for each of the major categories in this group, except public information and education. Workers in the second highest salary bracket were engaged in giving information to the public to a much greater extent than those in the other salary brackets.

Summary and Discussion

Summarizing the data obtained in the time study in the Maryland State Department of Health, it can be seen that roughly one-third of the working time was devoted to technical activities; one-third, to ancillary activities; and one-third, to administration and community activities. This distribution is essentially similar to that found in the five county health departments in Maryland, but there were minor differences, as might be expected.

State health department personnel devoted

somewhat less time to technical activities and somewhat more time to administration than did the county personnel. Since a local health department has primary responsibility for direct health services, it would logically devote relatively more time than a State health department to direct service, or technical, activities.

On the other hand, the State health department, probably because of its larger and more complex organizational structure, devoted more time than did the local units to management. It also devoted more time to the training of personnel, principally because of its training programs for local workers.

Another interesting difference was in the apportionment of time to public and professional education. The county units were involved in public education to a much greater extent than the State health department; the State health department, however, devoted three times as much time as the county health departments to professional education.

As a general pattern, it was found that the extent of participation in administration and community activities in the State health department was positively associated with position in the administrative hierarchy, level of education, and public health training, in much the same fashion as was found in the county health departments. In another part of the Yale study, it will be shown that only infrequently are personnel adequately prepared for these duties in their general college education or in their education in public health.

The various services differed considerably as to the amount of time that they devoted to many of the functional activities. Sometimes, as in the case of the laboratory service, differences appeared to be the natural outcome of the duties of the service. More often, however, differences did not appear to be related inherently to the fundamental character of the responsibilities.

The whole question of the relative importance of the several types of activity currently performed by health departments is a question that warrants serious consideration. The Yale study served merely to report existing practices, as a basis for further study.

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Supply of Rhesus Monkeys

As result of negotiations, the United States Mission to India and the United States Embassy in India have secured the agreement of the Government of India to permit for the period ending June 30, 1956, the continued exportation of rhesus monkeys for medical research and production of antipoliomyelitis vaccine. All needs must be certified by the United States Government through the Public Health Service.

Information concerning Public Health Service procedure and Certificate of Need forms may be secured from: National Institutes of Health, Room 1012, Building T–6, Bethesda 14, Md.

Experiments With Isoniazid As a Preventive Measure Against Tuberculosis

ISONIAZID, which has shown remarkable powers in the treatment of tuberculosis, shows promise of being equally potent as a preventive.

At the annual meeting of the National Tuberculosis Association in Milwaukee, May 23–27, 1955, Dr. Carroll E. Palmer and Shirley H. Ferebee, chief and assistant chief, respectively, of the Operational Research Branch, Tuberculosis Program, Division of Special Health Services, Public Health Service, presented their report, entitled "Experimental Studies on Prevention of Tuberculosis," in which they demonstrated the effectiveness of isoniazid as a preventive against tuberculosis in guinea pigs.

Methods and Results

The studies incorporated these basic principles: large numbers of animal subjects, controls, random allocation of animals to treatment groups, and unbiased observations. About 1,250 guinea pigs were first isolated for 3 weeks. The death rate during this period was about 1 percent per week. The 1,224 living pigs were distributed into 5 comparable experimental groups.

In the drinking water of the first 3 groups were placed concentrations of isoniazid in amounts of 0.25, 0.05 and 0.01 milligram per milliliter, respectively. There were two groups of untreated pigs, one held for challenge and one reserved as normal, uninfected controls. By weighing each animal every week and by measuring the amount of water consumed each day, it was found that the pigs drank a fairly constant amount of water every day. The amount of isoniazid taken daily in the 3 drug groups approximated 25, 5, and 1 milligram per kilogram of body weight.

All groups except the "normals" were challenged intraperitoneally with virulent tubercle bacilli. The normal pigs received a placebo challenge. The controls—those that received no isoniazid—died rapidly after the challenge infection, and by the 10th week only 7 percent remained alive. Eighty-eight percent of the normals—those that had not been infected—were still alive in the 10th week. The pigs that received 1 mg./kg. of isoniazid received some protection since they did not die as rapidly as the controls. Thirty-seven percent were still alive by the 10th week. The challenged pigs that received either 5 or 25 mg./kg. of isoniazid did not have a greater death rate than the normal pigs.

For the first 10 weeks after challenge with tubercle bacilli the daily dose of 5 mg./kg. was enough to protect the pigs against an infection that was sufficiently virulent to kill nearly all of the controls.

At this point, the investigators considered the problem of the effect of withdrawal of isoniazid. They withdrew the drug, 10 weeks after infection, from pigs selected at random in each of the three treatment groups. The pigs that had received 1 mg./kg. of isoniazid continued to fare better than the controls. The animals that had received 5 or 25 mg./kg. survived as well as the normal animals over a period of 26 weeks.

At the 26th week, 75 percent of the pigs that received at least 5 mg./kg. for only 10 weeks, 74 percent of those that received 5 or 25 mg./kg. for the entire 26 weeks, and 71 percent of the unchallenged normal controls were still alive. This part of the experiment appears to indicate that as little as 5 mg./kg. of isoniazid per day for only 10 weeks is sufficient to knock out a

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Prepared by the Tuberculosis Program, Division of Special Health Services, Public Health Service. The report mentioned will be available upon publication in the American Review of Tuberculosis.

virulent tuberculosis infection in guinea pigs.

Fourteen weeks after the date of the first challenge, randomly selected parts of each group of animals that had received 5 and 25 mg./kg. were rechallenged. Part of the original group of normals were challenged at the same time to obtain a new group of controls.

The new, untreated controls died rapidly, as expected. The animals that survived the first challenge while receiving isoniazid and had then been taken off the drug after the first 10 weeks, when rechallenged, did not die as rapidly as the controls even though they were not receiving the drug. This evidence suggests that a relatively small amount of isoniazid in the drinking water of guinea pigs not only protects them from getting tuberculosis but also allows them to develop a certain amount of resistance to a later untreated infection. This resistance is at least as great as has been produced in guinea pigs by vaccination with BCG.

The pigs that received 5 or 25 mg./kg. of isoniazid continuously during two challenge infections survived as well as the normals that had never been challenged.

Summary

A daily dose of isoniazid of not more than 5 mg./kg. of body weight, given in the drinking water, is apparently sufficient to protect guinea pigs completely from a large intraperitoneal challenge of virulent tubercle bacilli. This dose given for only 10 weeks after a virulent challenge was sufficient to prevent the appearance of disease after the drug was discontinued. Resistance to a later virulent infection, at least equal to that produced by BCG vaccination, develops in guinea pigs during the course of an isoniazid-treated challenge.

Whether isoniazid will be effective as a preventive of human tuberculosis depends on the results of controlled trials in large population groups, which are now being planned. Continuing experiments with laboratory animals will provide additional information essential to trials among human beings. Isoniazid has been used extensively since 1952 in treating tuberculosis, and its effectiveness and harmlessness have been conclusively demonstrated. The drug can be produced easily in large quantities, and its cost is low. Persons who are reactors to tuberculin or persons who exhibit suspicious shadows on X-ray films might be the first to benefit from the preventive and curative properties of isoniazid. These findings may mean that whole populations could be treated for as little as a penny a day per person.

CDC Slide Series

A series of approximately 35 color slides with descriptive notes has been prepared by the Public Health Service Communicable Disease Center. These slides emphasize the importance of communicable disease in the United States today. They outline Federal and State organization for control and show several phases of the center's program activities, such as orientation lectures, training courses, and other public presentations. Latest statistics are interpreted in diagrammatic and flow charts. Actual photographs of program activities are included. The series is available on loan in either 2- by 2-inch or 3¼- by 4-inch size. Requests should be addressed to James A. King, Jr., Special Assistant for Operations, Communicable Disease Center, Public Health Service, Atlanta, Ga.

Appraisal of Tuberculosis Case Finding

—*Des Moines and Polk County, Iowa*—

By ABRAHAM GELPERIN, M.D., Dr.P.H., LEON J. GALINSKY, M.D., and ALBERT P. ISKRANT, M.A.

IN an area and time in which the discovery rate of active tuberculosis is low, it is important to study present methods of case finding and diagnosis for program guidance.

How such a diagnosis becomes attached to a particular patient was the subject of a study of the tuberculosis control program in Polk County, Iowa. Our primary interest was in the succession of events leading to the definitive diagnosis among the 83 persons found to have active tuberculosis during the 2 years 1952 and 1953. The survey was undertaken in order to discover also to what extent the major case-finding methods were responsible for the diagnosis, the failures of accepted methods, some reasons for those failures, what might improve the application of current methods, and finally, whether new approaches should be introduced?

Des Moines and Polk County, Iowa, with a population of some 235,000 persons, have had a tuberculosis incidence pattern comparable to that in the rest of the State of Iowa. One health official directs the Des Moines City and Polk County Health Departments. The county hospital has a tuberculosis unit of 87 beds. The medical director of the tuberculosis unit is responsible for the care and management of the patients during both their hospital and outpatient care.

Organized community case finding for tuberculosis operates in three major areas:

1. Screening: By use of a mobile X-ray unit, concentrated on industrial groups; and by tuberculin testing of segments of the school child population. During the past 5 years, some 66,000 photofluorograms have been made by the mobile unit. Two-thirds of these covered industrial groups. Annual tuberculin testing of Des Moines public school children is carried out in kindergarten and in the 9th and 12th grades. Each county school has its entire population tested every 4 years. Positive reactors in these groups have usually amounted to less than 6 percent for any age group.

2. Contact investigation: Each patient reported to have active tuberculosis is visited at home by a public health nurse, who applies tuberculin tests to members of the family and to others considered to be close contacts of the patient. The nurse arranges for chest X-rays of these individuals. She also makes a home visit whenever a miniature film report indicates a shadow suggestive of tuberculosis and advises the patient on the subsequent steps to be taken—a visit to the family physician or to one of the diagnostic clinics.

3. Prolonged followup of all persons known

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to have had active tuberculosis: This is a regular function of the hospital's tuberculosis unit; for those patients who do not have legal residence in the county, the Christmas Seal clinic provides the service.

Of the 83 individuals with a diagnosis of active tuberculosis, only 7 (8.4 percent) were in the minimal stage, whereas 33 (39.8 percent) had moderately advanced tuberculosis, and 39 (47 percent) were considered far advanced. Four persons (4.8 percent) had extrapulmonary tuberculosis. Although a low discovery rate was anticipated in a low incidence area, the detection of only 7 minimal cases was of real concern.

Each patient diagnosed as tuberculous was visited by a specially trained public health nurse who was familiar with the objectives of the study. The nurse discussed with the patient and others close to him, and with the family physician and members of the hospital staff, the events related to the illness. The health department attempted to locate and review all previous X-ray films. Information was obtained concerning contacts and the results of their examinations.

A form was constructed to include this information, together with identification data; the motivation of the patient to seek medical care; a description of symptoms leading to diagnosis; place and date of diagnosis, stage and activity of the disease, and date of hospitalization; record of previous treatment for tuberculosis, including place, date, and outcome of treatment; and if previously reported as tuberculosis, date of report, county, or whether outside Iowa. If previous X-rays had been taken, the results and their interpretation were also entered on the form. Page 2 of the form provided space for data on contacts: name, age, and relationship to patient; tests for tuberculosis, with date and result of each test; miniature X-rays and 14″ x 17″ X-rays; diagnosis, whether previously known as having tuberculosis; and whether this tuberculosis activity was discovered by the present investigation.

Reasons for Coming to Diagnosis

Most of the patients (52 of the 83) came to diagnosis because of symptoms. Thus, approximately 60 percent of all persons with active tuberculosis were diagnosed because of a sense of illness which prompted them to seek medical care either in the office of the family physicians or in a special clinic. Two of the group with minimal tuberculosis, 20 of the moderately advanced and 27 of the far-advanced groups, and 3 patients with extrapulmonary tuberculosis were so motivated. In 9 patients, the diagnosis was made as a result of an examination which included a routine chest X-ray. Four cases were discovered because the patients were examined as contacts. Routine screening of hospital admissions at the veterans facility in Des Moines resulted

Table 1. Reasons for coming to diagnosis of 83 cases of tuberculosis diagnosed in Polk County, Iowa, 1952 and 1953

Stage of disease	Total cases	Reason for coming to diagnosis							
		Symptoms	Physical examination including chest X-ray	Contact investigation	Routine X-ray of hospital patients or employees	Hospital admission X-ray	Mobile unit X-ray	Follow-up of previously known tuberculosis	Postmortem examination
Pulmonary:									
Minimal	7	2	1	0	2	0	1	1	0
Moderately advanced	33	20	5	2	1	3	0	2	0
Far-advanced	39	27	2	2	0	0	2	3	3
Extrapulmonary	4	3	1	0	0	0	0	0	0
Total	83	52	9	4	3	3	3	6	3

Table 2. Time interval from onset of symptoms or first suspicion of tuberculosis to definitive diagnosis

Motivation and diagnosis	Time from suspicion of tuberculosis to diagnosis (months)								
	<3	3–6	7–9	10–12	13–24	25–36	>36	Unknown	Total
Motivation:									
Symptoms	22	4	3	3	10	2	5	3	52
Contact investigation	4	0	0	0	0	0	0	0	4
X-ray screening	6	1	1	1	0	0	0	0	9
Post-mortem examination	0	0	0	0	1	1	0	1	3
All other	9	1	1	1	0	0	0	3	15
Total	41	6	5	5	11	3	5	7	83
Diagnosis:									
Extrapulmonary disease	0	1	2	0	1	0	0	0	4
Pulmonary disease:									
Minimal	5	1	0	0	0	0	0	1	7
Moderately advanced	20	2	2	4	4	0	1	0	33
Far-advanced	15	3	2	1	6	3	4	5	39
Total	41	7	6	4	11	3	5	6	83

in the discovery of 3 residents of Polk County with tuberculosis; and X-ray examination of hospital staffs and patients hospitalized for other disorders revealed another 3 cases. The mobile X-ray unit screening service supplied the first evidence of disease in 3 patients; 6 were found through followup of previously known tuberculosis patients, and in 3, post-mortem examination supplied the diagnosis (table 1).

In this group of patients, 52 were men, 31 women. Approximately equal numbers of men and women made up the moderately advanced classification; but in the groups with minimal and far-advanced tuberculosis, there were more men than women The median ages in relation to stage of disease were: minimal, about 30 years; moderately advanced, about 45 years; far-advanced, about 55 years. Among those who sought medical attention because of symptoms, there were slightly more women than men in the group with moderately advanced tuberculosis, whereas in the group with far-advanced tuberculosis there were almost four times as many men as women.

For patients who came to diagnosis because of symptoms, the elapsed time between onset of symptoms and diagnosis varied considerably. However, there was no essential difference in this time interval between men and women; about the same proportion were diagnosed within 3 months. Of the 83 patients in the study, the largest number (22) were diagnosed within 3 months from the date symptoms of tuberculosis were first noticed (table 2).

Nevertheless, the median time between onset of symptoms and diagnosis is over 6 months, with 19 persons having a delay of more than 1 year. Persons coming to diagnosis for reasons other than symptoms were usually diagnosed within 3 months. Two persons in whom the diagnosis was established at post mortem had a duration of symptoms of more than 1 year.

It is of some interest that, according to these figures, the interval from first evidence of the disease to establishment of the diagnosis increased with advancing stages of the disease. All of the minimal cases with definable duration reached diagnosis within 6 months, as did two-thirds of the moderately advanced cases and a little more than half of the far-advanced cases. It required more than a year from the estimated date of onset to develop the diagnosis in 5 of 33 moderately advanced cases and in 13 of 34 far-advanced.

Of the 20 cases of moderately advanced tuberculosis coming to diagnosis because of symptoms of tuberculosis, 10 had been observed for possible tuberculosis for more than 6 months. Of 7 persons with positive screening X-rays,

Table 3. Opportunities existing before definitive diagnosis in 52 patients with symptoms of tuberculosis

Previous opportunities for suspecting tuberculosis	Stage of disease				
	Minimal	Moderately advanced	Far-advanced	Extrapulmonary	Total
Number of opportunities	0	14	18	2	**34**
Symptoms diagnosed as other disease	0	3	4	1	8
X-ray misread	0	4	1	0	5
X-ray positive [1]	0	3	4	0	7
Contact [1]	0	3	3	1	7
Previous tuberculosis [1]	0	0	6	0	6
Positive tuberculin test [2]	0	1	0	0	1
No opportunity	2	6	9	1	**18**
Total cases	2	20	27	3	52
Percent of total cases with previous opportunity for diagnosis	0	70	67	67	65

[1] Followup interrupted or not done. [2] Followup interrupted.

only 3 had been suspected originally; 4 miniature films were reinterpreted as indicating possible tuberculosis.

Of 27 cases of far-advanced tuberculosis coming to diagnosis because of symptoms of tuberculosis, 16 had been suspected by the patient for more than 6 months, including 4 cases which had been for more than 3 years. Five persons had had previous miniature films, of which 4 had been read positive and 1 misinterpreted.

Missed Opportunities for Diagnosis

At least 12 persons had previous suspicion of tuberculosis which could have led to diagnosis. We reviewed the records for all cases in which symptoms motivated the person to seek diagnosis to determine if we could identify additional opportunities for diagnosis which had been missed. The findings are presented in table 3.

For minimal tuberculosis, we found no evidence that the disease could have been suspected earlier, but for moderately advanced, far-ad-

Table 4. Results of contact investigation of cases of active tuberculosis diagnosed in Polk County, Iowa, 1952 and 1953

Type and stage of tuberculosis	Number of source cases	Number of contacts [1]				
		Reported	Examined	Positive 14″ x 17″ X-ray	Active tuberculosis	
					New cases	Previously known cases
Pulmonary:						
Minimal	7	11	10	0	0	0
Moderately advanced	33	95	91	2	0	1
Far-advanced	39	135	124	7	2	0
Extrapulmonary	4	14	12	1	1	0
Total	83	255	237	10	3	1

[1] For purposes of this table a contact is defined as a case that could be located and does not include "source" cases, that is, persons who previously had reported the case as a contact.

vanced, and extrapulmonary disease, missed opportunities could be considered in two-thirds of the cases. Following is a recast of our interpretation of "missed opportunities."

1. "Symptoms otherwise diagnosed" included cases reporting to physicians with symptoms that might have been associated with tuberculosis as well as with the respiratory tract disease that was under treatment. The patients were ultimately diagnosed as active tuberculosis primarily because of the persistence of symptoms.

2. "X-ray misread" included cases in which rereading showed abnormalities which were "suspicious" of tuberculosis and which should have led to further followup.

3. "X-ray positive—followup interrupted or not done" included cases in which the "suspect" did not return for scheduled examination or in which for some other reason followup observation lapsed.

4. "Contact—followup interrupted or not done" included cases in which repeated examinations were not made frequently enough or in which investigation was not instituted.

5. "Previous tuberculosis" including "positive tuberculin test"—followup interrupted or not done. We feel that adequate patient education and followup should have led to a diagnosis of reactivation of disease before symptoms motivated the patients to seek medical care. In none of these cases was an X-ray performed within 3 years of the date of suspicion of active disease.

6. "None." This group includes patients found as a result of sudden hemoptysis, or with a history of vague, "unimportant" symptoms.

Contact Investigation

We have previously noted that four of the active cases of tuberculosis are described as having come to diagnosis because of contact investigation (table 1). Table 4 presents the results of contact investigation of the 83 active cases of tuberculosis diagnosed during the period. The number of contacts named and examined approximated three per patient. Three previously unknown cases of active tuberculosis were found through the examination of 237 contacts. Many of these contacts had not had the opportunity to have repeated examinations at the time this tabulation was prepared and further cases may be discovered in subsequent months. The relationships of the three active cases to the source cases were wife, husband, and mother.

Discussion

In this group of patients, an average time lapse of about 3 to 6 months occurred between the onset of symptoms and the establishment of a diagnosis of tuberculosis.

Such a delay may be attributable partly to the patient himself, who may be slow to recognize the vague symptoms of fatigue, cough, and loss of weight as manifestations of tuberculosis In this sense, the delay may, indeed, be implicit in the disease itself.

Conversely, the long interval between onset of symptoms and diagnosis may be a medical responsibility. However, the diagnosis of active pulmonary tuberculosis is not a simple decision and may be equally troublesome for the family physician and for the medical specialist. This is true when tuberculosis is the only disease to be considered. How much more perplexing is the problem when the disease occurs in the course of other long-term illnesses. In this respect, also, the stage of the tuberculosis is the primary factor in the delay of diagnosis.

To remedy the delay in diagnosis, we must advocate repeated careful searching examination of the patient, with the possibility of tuberculosis constantly in mind. And for the patient, we urge earlier visits to the physician as soon as he is aware of ill health.

Because of our low tuberculosis rate, we must also emphasize case-finding measures which reach the groups with the highest prevalence of tuberculosis. Additional community control measures that may be applied are the X-ray screening of certain groups, such as transients, welfare department clients, old-age assistance beneficiaries, and persons interned in prisons and jails. The members of families and other close contacts of patients can be examined at regular intervals. As school populations are tuberculin tested, families and close associates of reactors may be similarly treated.

Perhaps the only major mechanism lacking for more complete case finding is the establishment of a "suspect registry." This registry would include all individuals who react to the tuberculin skin test, and all those who have suspicious, though stable, X-ray findings. Such a proposal is based upon the assumption that anyone who has had a tuberculous infection has within him the potentiality for subsequent active disease. With reporting centralized in a health department, these individuals could be followed at regular intervals by an official agency. They could also be impressed with the importance of disclosing their status to the physicians whom they may consult for other reasons. Operation of this plan over a number of years would develop a vast group to be held under observation. The plan is feasible only in a population with a low incidence of infection. Many small communities and some entire States present such a situation today, and it is in these areas that tuberculosis case-finding techniques could be augmented by the addition of a tuberculosis suspect registry.

An Important Date

Each month your health department and many hospitals, laboratories, schools, clinics, and homes receive a copy of PUBLIC HEALTH REPORTS, mailed to arrive on the 20th, or even earlier, depending upon geographic location of the subscriber.

Its pages carry timely research reports, analyses of current trends, new methods, concepts, and ideas, and topical reviews for the busy scientist, teacher, or public health worker. Capsule coverage of important public health meetings, like those of the American Public Health Association, help the PHR reader.

Not all our readers receive the journal on the delivery date. An official copy is trickled down to them through a series of other readers. Sometimes the trickle slows to a complete halt.

You can have your personal copy promptly. Use the subscription blank on the inside back cover. Let the 20th of each month be an important date for you, too.

Health Departments And Seafood Conservation

By A. L. CHAPMAN, M.D.

FOR at least 50 years health departments have worked assiduously to provide sanitary water supplies. They have cooperated with the Food and Drug Administration to make foods safer to eat. As a result of these efforts waterborne epidemics rarely occur and food poisoning outbreaks usually are self-limited and localized.

Health departments have recognized the fact that the quantity and the availability of water is as important to the health of the Nation as the bacterial and chemical quality of water. The time would now seem propitious for health departments to evince the same degree of interest in the quantity and the availability of food.

Some interesting facts bear on this problem. Only about one-third of the world's estimated population of 2,200,000,000 people are well fed. The rest are either starving or they are living on substandard diets.

One of the principal reasons for this wholesale and worldwide dietary inadequacy is the fact that only a small portion of the earth's surface can be cultivated. Four-fifths of the earth's surface is covered with water. The other one-fifth is above the sea. Less than 12 percent of this land area of 36,800,000,000 acres is capable of producing food. A large part of the 88 percent of land not under cultivation is barren and few of these billions of barren acres ever can be made economically productive.

The Untapped Foodbasket

For many centuries the fertile elements of the soil have washed relentlessly down to the sea. Uncontrolled erosion caused a loss of top soil in which was mingled important nutritive elements. But the land's loss has been the ocean's gain. Even as the land became poorer, the oceans became richer. Nitrogenous substances and nutritionally valuable minerals leached from the soil became the fertilizer of the sea and supported luxuriant marine vegetation, generally food for the animal life of the sea.

Plankton pervade the ocean waters. They are to the sea what wheat and corn are to the land. They constitute the nutritional base of marine animal life. The waters of the earth contain billions of tons of planktonic materials that never have been harvested nor have they ever been used on any large scale to serve man's purpose.

By increasing the production and stimulating a higher consumption of fish and shellfish, at least indirectly we can tap that prolific foodbasket, which is the sea. The people of the United States are among the lowest per capita fish consumers in the world. This characteristic is not irreversible. Probably one of the best ways to reverse it would be to modernize shellfish production methods, more particularly the methods of oyster production.

Oyster Production

In one eastern seaboard State where a laissez faire attitude toward oyster production long existed, the annual oyster production dropped from 15 million bushels in 1883 to its present level of slightly more than 2 million bushels.

This drop in production in the oyster catch in one State represents a protein loss equivalent to 130,000 Hereford cattle. If this State had instituted a leasing policy in 1900, it is estimated that the current annual oyster yield, instead of being in the neighborhood of 2 million bushels, would approximate 20 million bushels. In several adjoining States the drop in oyster production, since the latter part of the 19th century, has shown a similar steady downward trend.

The reasons for this continuing decline in oyster production are known to marine biolo-

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gists and to enlightened oystermen. Unfortunately, the nutritional importance of oysters and other shellfish has not been publicized sufficiently nor well enough to motivate health agencies to give sturdy support to the handful of scientists and conservationists who unsuccessfully have been trying to reverse the downward trend in shellfish production for many years. Oyster production in the North Atlantic States has dropped to negligible proportions for many reasons. Among the more important reasons are uncontrolled harvesting, failure to adopt scientific methods of oyster culturing, and increasing amounts of water pollution.

The oyster is a nutritious article of diet. It compares favorably with milk, poultry, eggs, and meat in its content of essential amino acids. Oysters, like milk, contain an abundance of calcium. They are iodine rich. They are excellent sources of thiamin and riboflavin. Local health officers in coastline counties often comment on the fact that no pellagra or beriberi is found among the members of families who have a pile of oyster shells in front of their shacks. Some nutritionists rank oysters and clams in the category of milk as an exceptionally well-balanced food. And oysters are very digestible.

Many fallacies have crept into nutritional lore about shellfish. There is a misconception that oysters are unsafe to eat except during months that have an "R" in them. This is of course untrue since oysters, properly grown and properly prepared, may be eaten safely during any month that they are available. The reason for the decline in their use during the summer months is that these are the months during which oysters spawn. It is the season during which they are most likely to be thin, not so succulent, and therefore less profitable to harvest and vend. Also, there is likely to be more spoilage in the summer.

Even unscientific oyster farming is more profitable than dirt farming. Under controlled, ideal conditions, 4,000 bushels of oysters can be grown on a 4 acre oyster "farm" in 3 years, representing a yield of approximately 32,000 pounds of nutritious high-protein food. In sharp contrast, 4 acres of "run-of-the-mill" grazing land will support only one steer which yields about 600 pounds of dressed beef. It must be remembered, too, that steers must be fed and watered if they are to grow and fatten; oysters feed and water themselves.

An oysterman who cultivates an oyster farm in accordance with sound principles of farm management can make more money than a dirt farmer. The cultivation of a good acre of oysters can be 10 times as profitable as the cultivation of an acre of potatoes and 17 times as profitable as the cultivation of an acre of wheat.

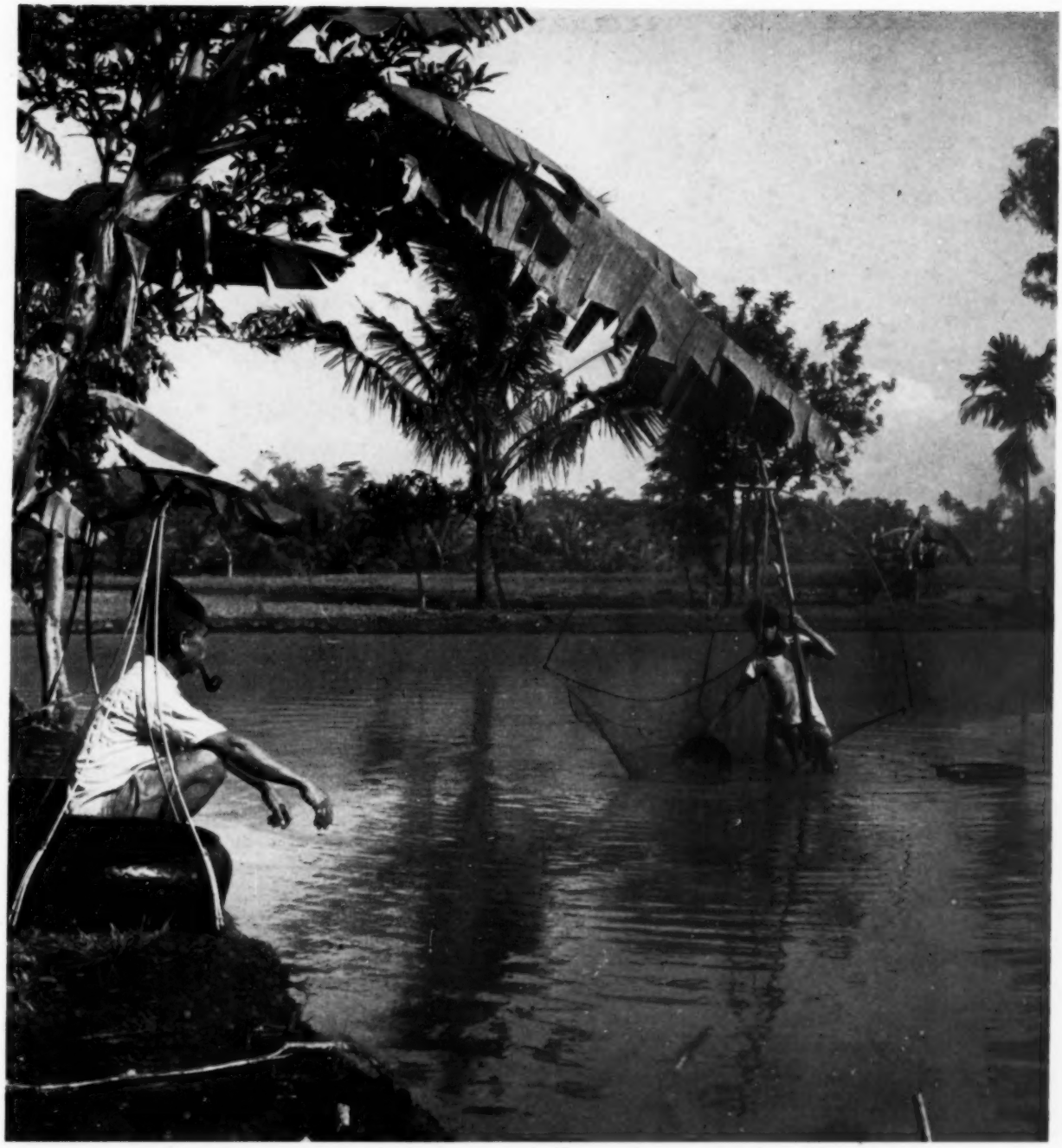
"Aquaculture"

In recent years, many dirt farmers, some 250,000 of them, have sensed the importance of fish and have constructed farm ponds in which fish are grown for food as well as for sport. The average yield of such ponds is about 200 pounds of fish per acre each year and well fertilized ponds can double that yield.

Congress recently recognized the importance of these ponds by providing special income tax exemptions for farmers who build them. It has been estimated that as many as 1,500,000 more ponds of this type could be wisely utilized.

In one of the coastal counties of a southern State, the maritime equivalent of a 4–H club has been organized among the students of a high school whose principal grasped the significance of seafood as a future source of food. A student's Marine Conservation Society was formed. The boys come from hardy waterman stock and rapidly are becoming seasoned watermen themselves. As an initial venture they planted two oyster beds with 8,000 bushels of seed oysters, which they plan to cultivate for fun, for experience, and for profit. Under the supervision of a dedicated marine conservationist, these boys will have an opportunity to learn scientific oyster farming sans the many superstitions that have burdened previous generations of watermen.

Until the turn of the century, oysters were able to hold their own against the destructive forces of nature. They managed to survive the cold of winter and the inroads made upon them by their natural enemies. It was only when man, unaware of the importance of conservation, began to denude the oyster beds, that the biological balance was tilted against the oyster, and once-famed oyster beds passed out of ex-



Inland fish culture in Java, Indonesia. The Javanese started raising fish for food about 1,200 or 1,400 years ago. United Nations photograph from "The Story of FAO."

istence except in the memories of a few old-timers.

Enough scientific research has been done to permit the rehabilitation of these barren oyster beds if oystermen would take the advice of conservationists. Recent developments in the science of "aquaculture" make it possible to culture oysters in such a way that "seed" suppliers do not have to depend upon the hit-or-miss methods of the past.

By the scientific analysis of such growing factors as salinity, turbidity, currents, and tem-

perature, the areas best suited to growing seed oysters can be selected. The seed oysters can then be planted in other selected areas where they will grow more rapidly to maturity. By skillfully dividing oyster farming into two distinct stages, the growing of seed oysters in some areas and the maturing of them in other areas, oyster farmers no longer need depend entirely upon chance to obtain good yields.

Important recent experiments at several biological laboratories along the eastern seacoast have demonstrated that seed oysters, which grow prolifically in warm southern coastal waters, can be transplanted successfully to cooler waters further north. There they can grow normally to toothsome maturity freed from the marine jungle competition into which they are born.

Health Department Interest

With many pressing public health problems on their way to solution, with human life expectancy approaching the 70-year mark, and with the world population steadily increasing, it is time to think much more seriously about the need to increase the world's and the Nation's supply of food. The functions of health agencies are changing rapidly as the character of the health problems they face continue to change. In addition, then, to supervising the sanitary quality of water and food, would health departments be remiss if they became more actively interested in efforts that are being made to conserve and to expand the Nation's food supplies?

Can increased health educational efforts help popularize the wider use of fish and shellfish produced under sanitary conditions as dietary staples and thereby increase the demand for these products?

Can health departments help to increase the production of shellfish by encouraging marine conservationists to introduce more modern and more scientific methods of oyster culture?

Inevitably, the world's current population growth will generate the pressures needed to bring about an increase in our supplies of food.

Would it not be more in keeping with the leadership role of health departments to anticipate these pressures and attempt to moderate and perhaps guide them by participating actively in the rapidly developing though often lagging food conservation program?

PHS Staff Announcements

Assistant Surgeon General William H. Sebrell, Jr., director of the National Institutes of Health since 1950, retired on August 1, 1955, after 30 years of active duty as a commissioned officer of the Public Health Service. He has accepted appointment as research consultant for the American Cancer Society and will direct the society's research grants program.

Dr. Sebrell has earned worldwide recognition as a medical scientist, particularly through his studies on the B vitamins. In the 1920's, he was a member of the Public Health Service team that established the dietary origin, prevention, and treatment of pellagra. He discovered the causes and cure of ariboflavinosis and has made important contributions to research in the dietary causes and treatment of liver diseases, the effect of pantothenic acid deficiency on the adrenal glands, nutritional effects of sulfa drugs, and the cause and treatment of blood abnormalities.

Dr. James A. Shannon, formerly associate director of NIH, has succeeded Dr. Sebrell. Dr. Shannon is also chairman of the Public Health Service's Technical Committee on Poliomyelitis Vaccine. A commissioned officer of the Service since 1949, he was associate director in charge of research at the National Heart Institute prior to his becoming associate director of the Institutes in 1952. Dr. Shannon was awarded the Medal of Merit for his work in World War II malaria control programs.

Dr. Shannon received his medical degree from New York University in 1929. He also received a doctorate in philosophy from the same university in 1935. After teaching at the university, he became director of research at Goldwater Memorial Hospital in 1942. From 1946 to 1949 he was director of the Squibb Institute for Medical Research.

A Positive Control For Coccidioidin Complement Fixation

By Frederick W. Bieberdorf, Ph.D., and Keith Wayne Chambliss, Ph.D.

The use of complement fixation tests for diagnosis of coccidioidomycosis by laboratories in "fringe" and "nonendemic" areas is limited by lack of human antiserum for positive control of the coccidioidin. Lyophilized rabbit antiserum is suggested for this purpose.

• • •

THE VALUE of the complement fixation test in suspected and proved cases of coccidioidomycosis has been adequately discussed by Smith and co-workers (*1*, *2*). Conant and associates (*3*) have also pointed out the value of complement fixation tests as an indication of the status of a coccidioidal infection. Schubert and associates (*4*) reported the results of their investigation with histoplasmin.

The continuous research on the use of complement fixation in the diagnosis of mycotic diseases emphasizes the value of this test as a diagnostic aid. As this value is recognized, the clinical laboratories will receive more requests for complement fixation tests. The serologist may properly interpret the results of any complement fixation test only if a positive control serum is used in each test.

In the endemic areas for *Coccidioides immitis* outlined by Smith (*5*), the clinical laboratories probably have little difficulty in obtaining an adequate supply of positive human serum. However, the clinical laboratories located elsewhere encounter considerable difficulty in obtaining or maintaining a supply of this control serum. These laboratories may receive only two or three requests for this complement fixation test each year. At present there appears to be no commercial source of a control serum for laboratories outside the endemic areas.

With this problem in view, a preliminary investigation was made to determine whether rabbit antiserum could be used to replace human antiserum as a source of positive control serum.

Dr. Bieberdorf, a mycologist, is research associate at the Southwest Foundation for Research and Education, Southwest Research Institute, San Antonio, Tex., and Dr. Chambliss is stationed at the Lackland Air Force Base at San Antonio.

Materials and Methods

Six young female white rabbits weighing from 5 to 7 pounds each were selected. Each of the rabbits was injected intraperitoneally with live spore mixtures of four strains of *Coccidioides immitis*. Ten days after this injection, 5 ml. of blood was removed from the ear of each rabbit, and the serum was tested for antibodies. Three of the rabbits showed high titer; all showed some titer.

As the rabbits were beginning to weaken from the intensity of the infection, they were bled approximately 50 ml. each by heart puncture on the 14th day after injection. The blood was permitted to clot, was centrifuged, and the serum separated. The serum of each rabbit was placed in a 50-ml. test tube and frozen until it could be tested. After each serum was again titered, the serums having similar titers were pooled and designated as serum pools 1 and 2. These two lots were dispensed in 10-ml. test tubes and refrozen until needed.

Autopsy of the rabbits revealed cysts, which were found to contain *C. immitis* endospores, in the peritoneal cavity.

Portions of the thawed serum pools 1 and 2 were dispensed into 2-ml. vials. The contents of the vials were frozen in a mixture of dry ice and isopropyl alcohol, desiccated, and sealed in vacuo. The vials of lyophilized serum were kept on the shelf at room temperature. When they were to be used, the serum solids

of each vial were dissolved in 2 ml. (the original serum volume) of distilled water. The reconstituted rabbit serum was heated for 30 minutes in a 60° C. water bath just before use. The heated bath was used as described by Dr. John F. Kent, department of serology, Army Medical Service Graduate School, in a private communication. He has found that the bath is necessary to destroy the nonspecific anticomplementary activity in rabbit serum. Serial dilutions of the reconstituted serum were then prepared for the titrations.

Human serum from a case of disseminated coccidioidomycosis with a high titer (reported as 1:512 by the department of mycology) was used for comparative purposes. Portions of this serum were lyophilized along with the rabbit serum and sealed in vacuo. These serum solids were dissolved in distilled water, and this reconstituted serum was heated for 30 minutes in a 56° C. water bath just before use.

Serums from normal rabbits and normal human beings were used in the investigation as negative controls.

A coccidioidin antigen for use in these complement fixation tests was supplied by Dr. Charles E. Smith of the School of Public Health, University of California.

Crude antigen preparations were also made in the laboratories of Southwest Foundation for Research and Education from cultures of the same four strains of *C. immitis* used for injection of the animals in antibody production. These four strains had been isolated from active cases of coccidioidomycosis. They were grown on the asparagine synthetic medium used by Smith and associates (*1*) and by Schubert and co-workers (*4*) in their investigations. The cultures were incubated for 6 weeks at room temperature in Roux culture bottles.

The complement fixation procedures were adapted from procedures of Kent (*6*). Titrations of all reagents used in these procedures were carried out according to the procedures outlined in the Army Technical Manual (*7*). The complement solution used in these tests was twice as concentrated as designated in the manual, but only half the recommended volume was used. Thus the same number of units of complement were used; only the volume was changed.

In the complement fixation tests the materials were added to 10 by 75-mm. test tubes and mixed thoroughly after each addition. They were added in the following order:

1. 0.25-ml. antigen dilution.
2. 0.25-ml. serum dilution.
3. 0.25-ml. complement solution (containing 2 full units).
4. All tubes incubated at 4°–7° C. for 16 to 18 hours.
5. 0.50-ml. antisheep hemolysin (containing 2 units).
6. 0.50-ml. 2-percent sheep cell suspension.
7. All test tubes incubated for 30 minutes in 37° C. water bath.
8. All tubes were compared visually with synthetic standards freshly prepared in 10-percent hemolysis steps; hemolysis was estimated and recorded to the nearest 5 percent.

The titer of a serum was recorded as the highest dilution which would permit less than 70-percent hemolysis to be exhibited in this complement fixation test. A control tube containing all components except antigen was run with each serum dilution, and a control tube containing no serum dilution was run with each antigen dilution.

Results

Preliminary titrations were performed to determine the optimum dilution for each antigen. Serial dilutions of the antigen, varying by a factor of 5, for example, 1:1, 1:5, 1:25, and 1:125, were prepared, and each of these dilutions was used for the titration of the antiserum.

The data obtained in the "crosshatch" titration of rabbit antiserum pool No. 1 with the coccidioidin furnished by Dr. Smith is shown in table 1.

The experiment showed a serum titer of 1:64 when a 1:25 dilution of this coccidioidin was used. This 1:25 dilution of Dr. Smith's antigen was used later in the titrations of rabbit antiserum. The crude antigens prepared in this laboratory also showed maximum activity at a 1:25 dilution with rabbit serum pool No. 1 if the antigens showed any activity. In contrast to these results, Dr. Smith's coccidioidin showed a maximum activity at a 1:5 dilution when used for the titration of a positive human serum in a "crosshatch" procedure identical to that outlined in table 1.

Identical titrations were performed on samples of rabbit antiserum pools Nos. 1 and 2

Table 1. "Crosshatch" titration of Smith coccidioidin and rabbit serum pool No. 1, tabulated in percent hemolysis

Antigen dilution	Serum dilution				Saline control
	1:8	1:16	1:32	1:64	
1:1	5	15	ac	—	—
1:5	0	0	25	—	—
1:25	0	0	5	50	—
1:125	5	15	20	95	—
Saline	—	—	—	—	

NOTE: Dash (—) = 100 percent hemolysis; ac = almost complete hemolysis (greater than 95 but less than 100 percent).

which had been stored in the frozen state, and samples which had been lyophilized. The results of these titrations are shown in table 2, along with results obtained when a lyophilized sample of pool No. 1 was titrated 6 months later. Table 3 shows the results of a similar titration of the one human antiserum available. The drop in titer from 1:256 to 1:16 on lyophilization could not be confirmed by repeating the experiment because no more of the human antiserum was available.

Discussion

There appears to be little difficulty in producing antiserum to *C. immitis* in rabbits. Although some rabbits develop a higher titer than others, standard immunological techniques can be used to follow the progress of the immunity reaction, enabling the worker to choose the animals showing the highest titers as a source of antiserum. As has been observed in other antiserum production, lyophilization destroys little if any of the antibody content. The lyophilized

Table 2. Titration of rabbit serum; antigen: 1:25 dilution of Smith coccidioidin, tabulated in percent hemolysis

Pool No.	Lyophilized	Serum dilution									Saline control	Titer
		1:1	1:2	1:4	1:8	1:16	1:32	1:64	1:128	1:256		
1	No	0	0	0	0	0	35	—	—	—	—	1:32
1	Yes	0	0	0	0	0	0	45	—	—	—	1:64
2	No	0	0	0	20	55	95	—	—	—	—	1:16
2	Yes	0	0	0	40	80	—	—	—	—	—	1:8
1	Yes [1]	0	0	0	0	0	0	55	—	—	—	1:64
Normal rabbit serum		—	—	—	—						—	[2]

[1] Stored for 6 months. [2] Negative.

NOTE: Dash (—) = 100 percent hemolysis.

Table 3. Titration of positive human serum; antigen: 1:5 dilution of Smith coccidioidin, tabulated in percent hemolysis

Lyophilized	Serum dilution									Saline control	Titer
	1:1	1:2	1:4	1:8	1:16	1:32	1:64	1:128	1:256		
No	0	0	0	0	0	0	10	10	65	—	1:256
Yes	0	0	0	0	15	75	ac	—	—	—	1:16
Normal human serum	—	—	—	—	—	—	—	—	—	—	[1]

[1] Negative.

NOTE: Dash (—) = 100 percent hemolysis; ac = almost complete hemolysis (greater than 95 but less than 100 percent).

products appear to be stable indefinitely at room temperature, which would permit shipment to, and storage by, small laboratories until needed.

The sharp drop in titer in the one human antiserum after lyophilization is not what would be expected. No conclusions should be drawn until additional human antiserums are available for testing.

Further investigations must be carried out before a lyophilized rabbit anticoccidioidin is placed on the market as a standard reagent. The most important question to be answered is the one concerning the specificity of the antibodies produced by rabbits and humans. It is possible that the rabbit antibodies titrated in the above experiments were specific for one kind of molecules in the coccidioidin, the carbohydrates, for example, while the human antibodies were specific for an entirely different kind of molecules, possibly proteins, but not carbohydrates. Admittedly this example is an oversimplification. Nevertheless, some indirect evidence makes the possibility worthy of investigation. Martin (*8*) has shown that an alcohol-precipitated carbohydrate-like substance from *Blastomyces dermatitidis* antigens fixed guinea pig complement with rabbit antiserum but not with human antiserum although the protein portion of the *B. dermatitidis* cells did fix complement with the same human antiserum. Hassid and co-workers (*9*) have also shown that carbohydrate materials from coccidioidin failed to fix complement with human antiserum. The same human antiserum did fix complement with the original coccidioidin.

Of primary importance would be the comparison of the complement-fixing abilities of various purified fractions of coccidioidin with rabbit antiserum and with human antiserum. Additional investigations need to be accomplished; this is contemplated as soon as funds are available for this purpose. With such additional data, it appears possible lyophilized rabbit serum may become available to laboratories commercially.

Summary

Young female rabbits weighing 5 to 7 pounds were injected intraperitoneally with live spore mixtures of *Coccidioides immitis*. Fourteen days following the injection the rabbits had developed a high titer of antiserum specific for *C. immitis*. This antiserum, when lyophilized and sealed in vacuo, was shown to be stable indefinitely at room temperature.

It is suggested that, after further investigation, such an antiserum preparation might be used as a positive control serum of known titer by laboratories which have no available source of supply of fresh positive human antiserum for *C. immitis*.

Problems which remain to be investigated are discussed.

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1955 National Health Forum

AIR POLLUTION, mental health, chronic diseases, radiation, home accidents, and personnel shortages emerged at the 1955 National Health Forum, New York, March 23–25, as targets for the immediate future.

From the opening address by Ellsworth Bunker, president, American National Red Cross, to the 35th annual meeting of the National Health Council, the audience faced a series of challenges to the public health profession. Focusing on one of the challenges, Dr. Daniel Bergsma, State health commissioner for New Jersey, noted that although his State has been alert to the need for developing public protection against radiation, the swift pace of nuclear events finds current programs behind impending needs.

Mr. Bunker pointed out that, as the focus of health and welfare programs has shifted from relief of the sick and underprivileged to the improvement of the community as a whole, the need has grown to pool resources in comprehensive programs. He urged that volunteers support recruitment and training of health personnel; that they support education for improvement of mental health; that they cooperate in reducing the burden of handicapped or delinquent children; that they share in the immediate establishment of health plans for coping with national disasters; and that they encourage their neighbors to establish State and local health councils. Through such working partnerships, he said, "We can set an example of what can be done by free men to improve the welfare of the human race. This spontaneous association of men of good will can create a bridge of understanding among the nations which would overpass political antagonisms."

The probable changes in the economy, as a basis for planning future health programs, were described by Dr. Dexter Merriam Keezer, vice president of the McGraw-Hill Publishing Co., with the specific provision that he assumed that his neat trend lines would not be disheveled by nuclear weapons. He also entered a reservation posed at an earlier date by Aristotle: "It is part of probability that the improbable happens."

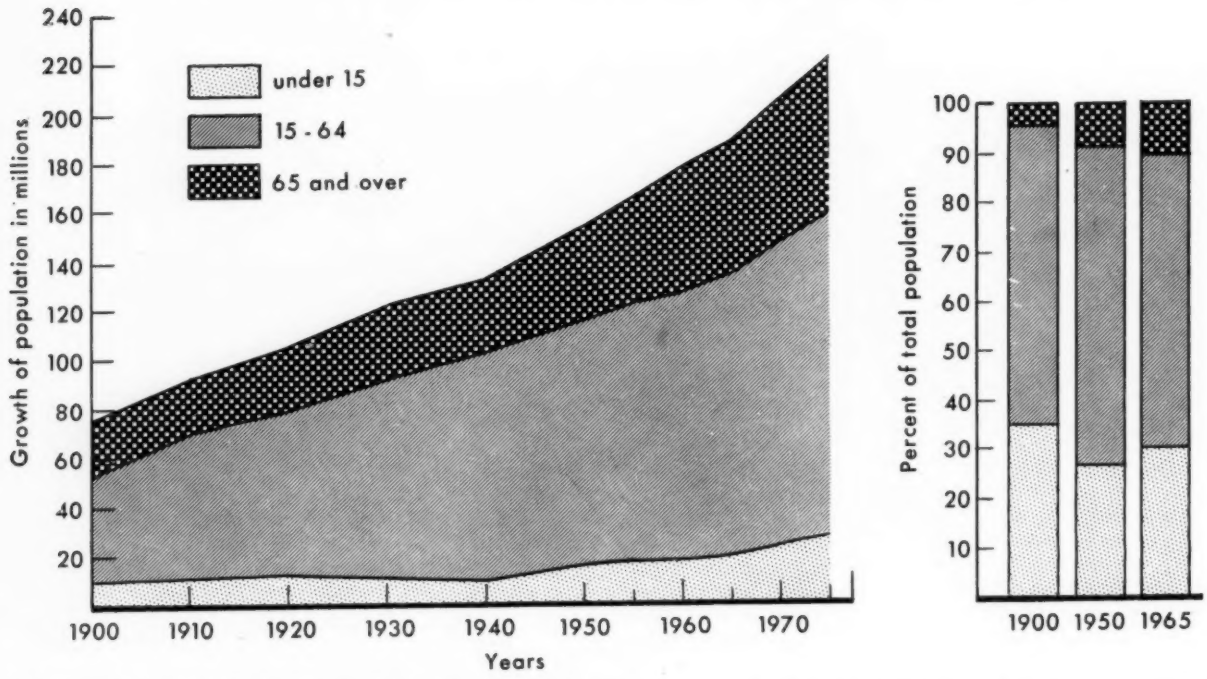
By 1965, he forecast an American population of 190 million, an increase of 26 million above the present level, a number nearly twice the present population of Canada.

He pointed out that the population is not merely aging: It is growing more at the ends than in the middle. He forecast by 1965 an increase of 25 percent in the age group above 65. They would then be 9 percent of the total, as against 4 percent in 1900. The increase for children under 15 was forecast at 17 percent, as against 13 percent in the working-age group. But he predicted that rising productivity would permit the working-age population to carry the increasing burden of children and retired elders without strain. He also predicted a slight further gain in the minute excess of females over males. For this reason, he also forecast an increase in the number of women working in industry, with possible ill effects on female life expectancy.

He said the trend to move from farms to urban or suburban areas would continue, with further aggravation of the problem of developing community health facilities in fringe areas.

Automation of many clerical jobs, he felt, would pose special mental problems for white-collar workers who place high value on the "continuity and stability of what they do." As a sample of things to come, he cited a data processing machine which with 10 man-hours does

Growth of population age groups and age groups as a percentage of the total population



This chart is based on the chart included in "Some Economic Factors in Forecasting the Nation's Health," the paper presented by Dr. Dexter Merriam Keezer at the National Health Forum, March 23, 1955.

work which formerly required 1,800 man-hours. The maintenance man for this machine requires a degree in physics.

On the whole, he foresaw great material gains in earnings and possessions, equivalent to an additional $400 per person per year in present purchasing power. Moreover, he felt that these material gains would be shared broadly by most of the population.

Dr. Otis Anderson, chief of the Bureau of State Services, Public Health Service, questioned whether, without a marked change in public policy, there would be enough health personnel and facilities to permit the economy to expand as Dr. Keezer predicted. Without adequate health services, he suggested that productivity would suffer, and the incapacity of the older members of the family population would indeed be a burden on those of working age. He advocated as a measure to offset the rise in chronic diseases a medical form of DDT: Detection, Diagnosis, and Treatment. Facilities for care and treatment of older people, he emphasized, did not necessarily imply complete nursing care or elaborate hospital facilities. A private home, properly designed and located, or household help would in many instances suffice. As to patterns of population movement, he asserted that tax structures, as broadly based as those of the typical health department, would be necessary to meet the rising demands for rural and suburban health services.

In view of the trend toward a broader distribution of income, Dr. Anderson cited figures demonstrating how protection against hospital, surgical, and medical expense has been extended to millions in the population. Most of this extension, he said, has come about since 1945, largely through collective bargaining between labor unions and management.

Dr. William A. Sawyer, consultant to the International Association of Machinists, emphasized that demands for health services are growing more rapidly than population. This is not a simple need for medical care, he said, but a need for better public health methods, a better distribution of health centers, and effective staff. The crucial question, he said, is not what economic trends will do to health

services but what health conditions will do to the economy. To emphasize this point, he reported that in West Virginia, 376 families on relief were rehabilitated at less than the $225,000 spent annually on their maintenance, with the result that they now earn more than $500,000 a year.

The rise in population, suggested Dr. James Perkins, managing director of the National Tuberculosis Association, might produce crowded housing conditions which would reverse the declining trend of tuberculosis. He expressed concern also with the prospect of population movements and growth in areas, certain western States and migrant labor camps, which do not now provide adequate health services. The increased leisure predicted by Dr. Keezer would not, he said, necessarily improve mental health if we lack plans for utilizing such leisure. He stressed the point that spiritual leaders of all cultures have held that healthy minds and emotions are far more to be desired than material possessions.

At luncheon, delegates heard leaders in the field of communications discuss fundamentals of using magazines, newspapers, and broadcasting for effective health education and information.

Regulation of fluorides in public water supplies is a responsibility of the entire community, not that alone of the dentists, physicians, or

Gains and losses to the medical profession

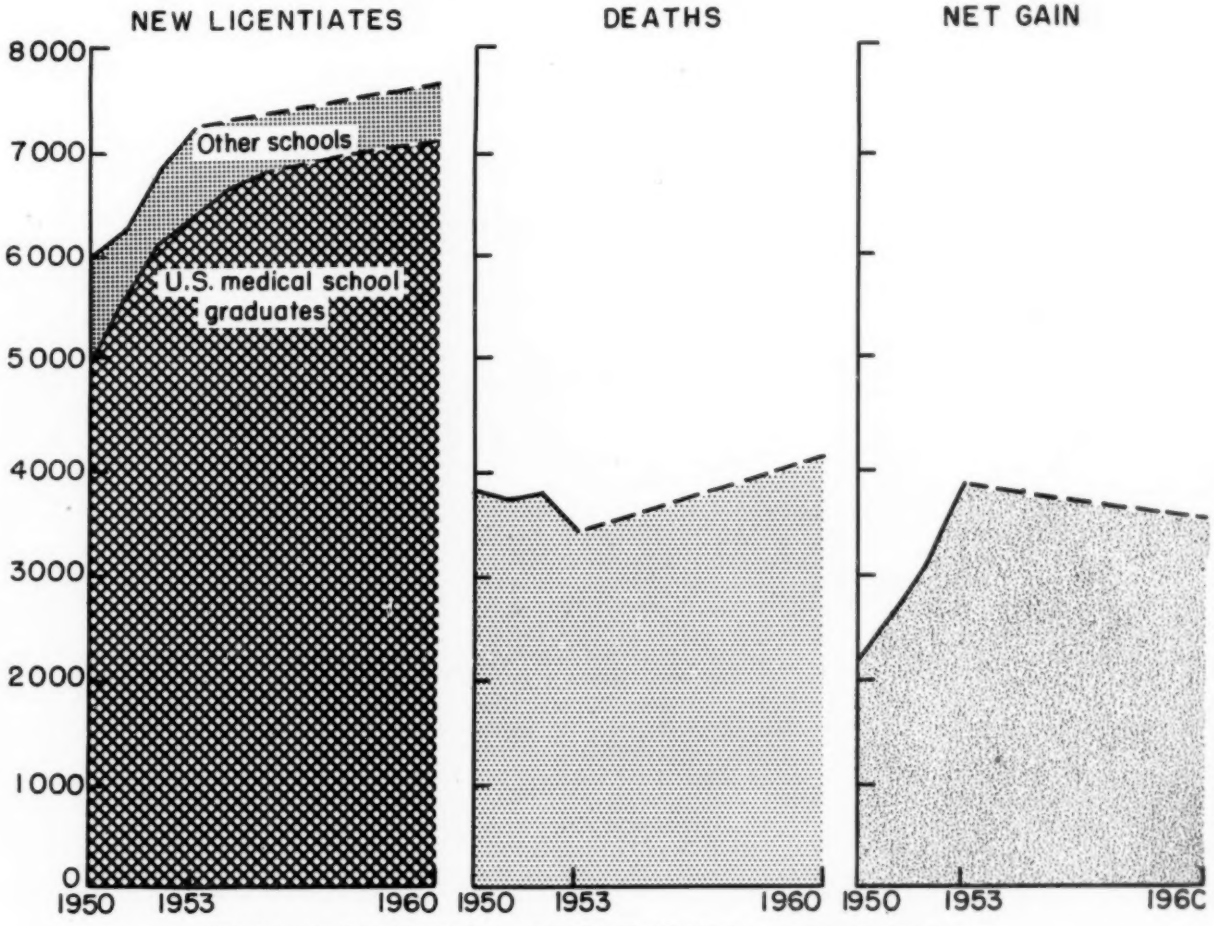


Chart prepared by the Division of Public Health Methods, Public Health Service.

If present trends continue, the net gain to the medical profession is expected to be about 3,500 in 1960. Deaths among physicians will probably rise to 4,100 in that year. Licentiates representing additions to the profession will be about 7,600. Of these, 7,100 will be graduates of approved medical schools in the United States.

the health workers, and the chief function of the health profession is to make facts available, according to a panel which included two members of the American Dental Association, Dr. J. Roy Doty, secretary of the Council on Dental Therapeutics, and Herbert B. Bain, director of the association's Bureau of Public Information. Also participating was Al Schottelkotte, reporter-columnist for the *Cincinnati Enquirer*, whose home city of Cincinnati rejected fluoridation by a referendum in 1953.

Dr. Bergsma's paper and excerpts from other addresses at the conference follow below.

In other action at the National Health Council meeting, Dr. Hugh R. Leavell, dean of the Harvard University School of Public Health, was installed as president, and Dr. Leona Baumgartner, health commissioner of New York City, was chosen president-elect.

The forum also heard a discussion of prospects for care of the long-term patient, analysis of the recommendations of the Hoover Commission on Organization of the Executive Branch of the Government, and comments on the recruitment of career workers in public health.

Radiological Health Services in New Jersey

The increasing use of more potent radiation sources, including radioactive isotopes, in this Nation and in the State of New Jersey, has already presented problems to those charged with responsibility for the preventive and constructive phases of public health administration.

Daniel Bergsma, M.D., M.P.H., commissioner, New Jersey State Department of Health, presented this paper at the 1955 National Health Forum of the National Health Council in New York City on March 23, 1955. Other papers from the forum follow in brief form.

Under the caption of "radiological health," there has developed a series of activities, unique in concept, with which official health agencies have begun to concern themselves.

Beginning in 1946, the Atomic Energy Commission permitted the distribution of an entirely new family of reactor-produced radioactive materials to authorized users for any purpose deemed by the Commission to be in the public interest. Contingent upon the sale of radioisotopes has been a series of requirements for radiological protection designed to safeguard individual and public health. We have tended to accept without comment this approach by the Atomic Energy Commission to the distribution of potentially hazardous materials. However, be assured that this is a remarkably modern concept and practice. This was possible because the Atomic Energy Commission was a governmental agency and was authorized by law so to do.

Major manufacturers of dangerous and toxic materials may label their products and indicate precautionary measures to be taken in handling the hazardous substances, but they could not take steps to reassure themselves that the precautions were being carried out.

If the control features used by the Atomic Energy Commission had been applied from the outset of the use of radiation, dating back almost 60 years, there would not now be the same uneasiness which exists in the minds of thinking individuals with respect to effects of radiation on public health.

The Atomic Energy Act of 1954, for the first time, opened the door for the development of the competitive use of private atomic energy within the United States. We can anticipate, I believe, that in a relatively short period, many of us will find in our respective jurisdictions, new users of nuclear energy.

The presence of nuclear power as a competitive process in the national scene has been stifled, in a sense, by the extreme caution necessary to provide adequate radiological health safeguards. This problem is very real. If we are to encourage the optimal growth of this awe-inspiring source of energy and simultaneously fulfill to the utmost our primary responsibilities as overseers of the environ-

mental well-being of the Nation, we must be capable of presenting a sympathetic but firm understanding of the problems generated by this expanding activity.

Many of us had our first introduction to atomic power by way of civil defense activities. The terms "radiation monitoring," "fission products," "radiocontamination," and so forth, have become increasingly familiar to us. The single exposure, lethal dose of 450 roentgens of whole body radiation became axiomatic. It took considerable reorientation in our radiological training to meet the first peaceful uses of atomic energy: radioiodine-131 and radiophosphorus-32 in clinical medicine, cobalt-60 in industrial radiography and cancer therapy, and strontium-90 in beta-thickness gauges. We have had to develop different concepts of instrumentation and shielding designed for a maximum permissible exposure level of 300 milliroentgens per week for industrial workers.

I certainly cannot advise on how to acquire these capabilities rapidly and yet in a practical manner. However, I can describe what has been done in the New Jersey State Department of Health to develop authority and competence.

It has been demonstrated that public health engineers, industrial hygienists, and public health physicians and nurses, already well versed in the intricacies of developing sound occupational health programs, are able to adapt themselves to this new science. There should be no hesitation in the future in asking that each such staff member prepare himself to understand and apply radiological health principles. The public health administration of these principles is no different from that of any other official health responsibility.

The New Jersey Program

Our experience in New Jersey suggests that certain factors are essential to the development and success of a radiological health program:

First is training for field and office personnel.

Second is supportive legislation in order to define the scope of authority to recommend radiological health controls wherever necessary. This legal base was brought about in New Jersey by the Public Health Council of the State of New Jersey exercising its existing power with the adoption, effective December 15, 1952, of chapter VI, on radiation, as part of the State sanitary code.

This chapter is as follows:

"Regulation 1—Application of chapter.

"(A) X-ray machines and all other sources of radiation shall be shielded, transported, handled, used, and kept in such manner as to prevent all users thereof and all persons within effective range thereof from being exposed to excessive dosage of radiation. Owners or users of sources of radiation shall not expose themselves or permit others within effective range to be exposed contrary to regulations which may be promulgated by the State Department of Health relative to sources of radiation.

"(B) Every incident of exposure to radiation in violation of the aforementioned regulations or of this Chapter shall be considered a separate offense."

The simplicity and brevity of this chapter and its wide latitude for interpretation and enforcement make it a powerful instrument for radiological health control. Easily adopted departmental regulations that are amended readily, relating only to those sources of radiological health hazard demanding immediate attention, may be promulgated while the broader powers of the department in the entire field of radiological health remain unaffected.

To date the only departmental regulations which have been issued are those relating to fluoroscopic shoe-fitting machines.

Third is the preparation of a concise declaration outlining proposed activities in the field of radiological health. This is stated in New Jersey's radiological health program, formally approved on May 19, 1954. The findings of our earliest exploratory field activities were utilized to develop a realistic program.

Fourth is the ability to impart authoritative radiological health information and specialized advice to all interested parties.

Facing Up to the Problems

Now we must be prepared to operate in the realm of tomorrow and face the problems associated with nuclear power reactors, the most concentrated energy source thus far devised for peaceful purposes and, at the same time, poten-

tially the most concentrated source of toxicity from radiation.

Every nuclear reactor produces radioactive material in direct proportion to its power capabilities. Coupled with this tremendous production and waste potential is the possible exposure to the injurious effects of ionizing radiation not only of the industrial population that is required to operate this equipment but also of every person who may come in contact with the resultant byproducts, the general population as well as the industrial worker.

Geneticists and physicists warn us that our concern must be for future generations as well as for ourselves. Exact authentic data on the effect of repeated small or moderate doses of radiation on human genetics are not available. This is not the appropriate place for a recitation of symptoms and signs or medical diagnosis or therapy for varying degrees of overexposure to radiation. However, it is quite well understood and accepted that unnecessary exposure to radiation is best avoided.

Whether or not State and local health agencies prepare themselves to answer the many questions that result from the expansion of this radiation energy field, do not doubt that this expansion will take place. We should prepare, as soon as is feasible, to be in a position to function as effectively in this area as we have in other health areas in the past.

The nuclear reactor has the greatest potential for environmental toxicity of any other installation. This fact makes it essential that a health department prepare to control the environmental health problems which will result.

A mechanism is needed whereby plans for nuclear reactors are reviewed for design safety, location, area encompassed, and other pertinent safeguards, such as alarm systems, and in some situations perhaps for population evacuation measures. Also it is probable that water, air, foliage, and soil will need to be monitored in the vicinity of such installations for baseline data, so that subsequent contamination can be readily detected.

This extensive monitoring program is more readily understood when the realization comes that the radioactive material which would be released from a nuclear reactor accident is, in part, extremely long lived and hence is more dangerous and more concentrated than those radioactive materials from an atomic bomb detonated high in the air.

However, to retain a proper perspective, it is apparent that the average State program should be founded on actual conditions rather than on eventualities that are too remote.

Very few persons are currently exposed to nuclear reactors. A far greater number of people are exposed to excessive radiation from fluoroscopic shoe-fitting machines, X-ray units, and fluoroscopy. Possibly more persons are in contact with cobalt-60 for treatment of cancer and for radiography, with beta gauges and radium and polonium static eliminators than are as yet occupied in nuclear reactor units. We must in our total planning be alert to the summation of radiation effects from all sources and also to the cumulative factor.

The radiological health program in New Jersey has crystallized within the past 3 years. We were fortunate in receiving assistance in this period of rapid growth from the United States Public Health Service, in the form of trained personnel assignments. A public health physician, experienced in local health problems and atomic medicine, was loaned for 1 year. A sanitary engineer, trained in nuclear physics, has been in charge of the program activities for 2 years. State personnel are now taking over these duties.

We have not contemplated and are not attempting rigid regulatory controls of all sources of ionizing radiation. In terms of public health administration, public health practice, and, last but not least, public health education, a tremendous task remains to be done.

Two attitudes are found among officials concerning the public health hazards connected with the use of radiation sources. One is the "police" type of control—the strict supervision by codes, ordinances, regulations, licensing acts, and the like, of anything and everything that may possibly cause persons to be exposed to radiation. We are aware of the difficulties engendered by the interpretation and enforcement of these acts when they refer to highly technical subjects.

The other attitude stems from an awareness of the fact that many uses of radiation are capable of self-regulation to a marked degree,

Patterns for Different Sized Radiological Health Units

Basic Program

Area of interest: fluoroscopic shoe-fitting machines; static eliminators; thickness gauges; industrial and medical radiography.

Equipment:

Ionization survey meter (Cutie Pie)	$275
Geiger-Müller survey meter	245
High-level dosimeter and charger	200
Personnel monitoring set	150
Landverk analysis unit	100
Total	$970

Personnel: engineer (full time); clerical; supervision (medical—part time).

Operating expenses: training; travel; expendable supplies; meetings, books, and so forth.

Intermediate Program

Area of interest: basic program *plus* medical and industrial isotopes; X-ray installations (dental, veterinarian, therapeutic); consultation (reviewing plans, laboratories, application of isotopes).

Equipment:

Basic program	$970
Plus:	
2 Victoreen R meters	1,500
1 personnel monitoring set	150
Total	$2,620

Personnel: supervision (medical); engineer (full time); engineer (part time); clerical.

Operating expenses: training; travel; expendable supplies; meetings, books, and so forth.

Comprehensive Program

Area of interest: intermediate program *plus* analytical laboratory (air, water, biological waste, industrial waste, film badge service).

Equipment:

Intermediate program	$2,620
Plus:	
Laboratory scaler, mount, and timer	885
Proportional counter	360
Air-sampling equipment	500
Liquid-sampling equipment	100
Standards	50
Miscellaneous supplies	500
Film badge (contract)	500
Total	$5,515

Personnel: supervision (medical); 2 engineers (full time); physicist; clerical.

Operating expenses: training; travel; expendable supplies; meetings, books, and so forth.

such as, for example, the administration of radiation for therapeutic purposes. The effectiveness of this second attitude is based upon the establishment of mutual confidence and rapport with the professional and industrial groups who commonly utilize radiation sources.

Our basic principles, throughout, are relatively simple in statement:

1. That we desire to promote the most desirable management of radiation sources for the protection and improvement of the public health, and

2. That radiation exposure serving no useful purpose be avoided.

The foregoing represents our philosophy and experience in the radiological health field to date. The problem of practical application remains. Many may query, what do we need to start this project?

A public health radiological health program can be built up slowly from a one-man unit with limited equipment to a comprehensive program, as the need develops. A good program grows under the impetus of its own needs and potentials.

In the accompanying inset appears a suggested schedule I have drawn up for initiating and developing radiological health units. Only equipment costs are shown. This was done because travel and personnel costs can more appropriately be written in accordance with current and local situations.

Tomorrow's Atom and You

PHR brief

The path which developing knowledge has followed with respect to atomic energy has been a tortuous one. Beginning before the end of the previous century with the discovery of radium as a naturally radioactive element, there

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has been a slowly evolving understanding of what we like to think are the fundamentals of radioactivity.

It was soon recognized that the radiations of radium were capable of killing living cells and that slowly developing degenerative changes of tissues exposed to these radiations could occur. The radiations of radium were applied to medical purposes and to a certain extent utilized in industry. The extraction of radium from its parent ore, pitchblende, was a laborious and costly process. The production was quoted in terms of milligrams, and a gram of radium with a radiation value which we now call a curie, cost about $70,000. Over the years the stock of separated radium supply grew until finally about 1 kilogram had been separated.

Small as this total stock seems to be, the studies made of radium and other naturally radioactive elements led to the very fundamental knowledge on which our modern concepts of radiation protection are based. Furthermore there developed the technique of supplementing X-ray therapy with local implantations of radium and radon which have been of so much value in the treatment of many forms of cancer.

Significant as were these developments, the rate of progress was greatly increased by the development of accelerators of energy sufficient to induce nuclear reactions. The production of radioactive isotopes unknown in nature became possible for the first time, and these in turn were the keys that opened the doors to new knowledge in biochemistry and physiology. The fundamental studies of the physicists in turn led to the further great wartime accomplishments of the Manhattan Engineer District and the development of our present atomic energy program.

We now have in our hands modalities of research which only a few years ago were merely the ephemeral substance of dreams. Already there has occurred a tremendous revolution not only in the technology of biological and medical research but indeed in the concepts of the nature of material substance and the character of life itself. From that which already has transpired and has come into the field of human experience and knowledge, one may make certain predictions with reasonable confidence in their reliability. We must never forget, however, that we merely stand on the threshold of a new era of knowledge. Phenomena and concepts, of which today we do not even speculate, surely lie in the future. With these qualifications and reservations arising from the sense of our intellectual limitations, I wish to discuss a number of specific topics.

Medicine

We are in the early period of great advances in biochemistry. These will surely have profound impact not only upon our knowledge of disease but also upon the methods of diagnosis. Reactions which may be brought about in the various physical states make it possible to introduce radioactive atoms as tracers into the most complex and delicate molecules. One can visualize that the diagnostic approach of the physician of the next 25 to 50 years will revolve around the quantitative measurement of the behavior of specific enzyme systems. The laborious and crude chemical techniques of today will be replaced by precise and rapid procedures of far more discriminating character through the introduction of radioactive atoms into highly specialized compounds of physiological importance. In our future medical schools, the teaching will of necessity emphasize the dynamic characteristics of intracellular reactions which can be observed in the living state without injury to the individual.

We may anticipate that within the next 50 years epidemics from infectious agents will have ceased to be a major threat to life and health. With the possibilities that are at present foreseeable we may anticipate that the scourges of parasitism of both animals and man that retard the development of tropical peoples will have been overcome.

This changing prospect with respect to infectious disease means that we must concentrate more and more attention on the understanding of the mechanisms of physiological deterioration with age and the specific diseases of the later decades. We may anticipate that through the combined efforts of the chemist and the radiologist we will be able to release powerful radiations within pathological cells to achieve either a cure or satisfactory sup-

pression of cells which have undergone neoplastic change.

While we may anticipate great improvement in the processing of atomic fuels, the same principles extend directly into such areas as the production of synthetic foodstuffs and the utilization of solar energy through the process of photosynthesis. Inherent are the prospects of new and greatly improved drugs for medical purposes and the production of compounds necessary to nutrition.

Public Health

It seems obvious that we are already in the midst of a profound change in the character of our public health problems. While the established concepts of epidemiology still hold, we see progressively greater preoccupation with substances which, in contrast to the living infectious agents, are not capable of multiplication but are capable of spontaneous transformation or transmutation. In the instant of release of radioactivity, the atom changes from one element to another which in some cases is capable of still further radioactive change. There is a consequent change in the behavior of the material in the chemical sense. It is a phenomenon remotely comparable to the sudden appearance of a mutation in a living cell line.

As the utilization of atomic energy for industrial and scientific purposes multiplies, as inevitably it will, the responsibility for insuring that the environment occupied by people, and by the biological systems upon which human life depends, shall not be contaminated to a level of population hazard. In general, this is equivalent to saying that the environmental contamination must be maintained at levels considerably below those considered significant as hazards to individuals.

The essentials of protection from dangerously radioactive substances are: time, distance, shielding, and containment. All radioactive substances decay and in time result in ordinary stable elements. The times required vary from minute fractions of a second to many years. The longest half-life of a fission product of any biological significance is approximately 20 years, although smaller amounts of elements of less biological consequence are formed that have half-lives as long as 33 years. Consequently, inherent in considerations of environmental radioactive contamination is the element of time.

From the standpoint of external exposure to radiation, distance is extremely important as a protective measure. Intensity falls off as the square of the distance from the source, and to this there is a further reduction from attenuation by the air. A source which may be dangerous close up may be quite innocuous at a moderate distance.

All radiations may be stopped by appropriate and adequate shielding. The character of the material used for shielding and the amount of it are partly determined by the nature and intensity of the radiation concerned.

Containment is the fourth essential factor in radiation protection. Materials which would be hazardous if released to the environment in quantity may be held in storage until radioactive decay has taken place and the levels of radiation reached are acceptable in the disposal area. At Hanford large quantities of highly radioactive fission products are held in underground tanks for many years. Materials which might be hazardous are thus kept confined and do not enter the environment where they could be a risk to life.

As with all toxic substances, there are levels of exposure to radiation and various radioactive elements internally which can be said to be safe in the sense that no significant injury may be detected over the lifetime of the individual. These permissible or tolerance levels are determined through careful study of all available information derived from human experience and animal experimentation. In the United States the National Committee on Radiation Protection considers these matters and advises on the levels which may be accepted as permissible. Their recommendations are published from time to time by the United States National Bureau of Standards.

These developments mean that the sanitary engineer and the public health worker, not only now but especially in the years to come, must give increasing thought to the control of radioactive substances in the environment and the manner in which such substances may enter the various life cycles that constitute our food

chains. It requires diligence and a redirection of public health education.

That it is perfectly feasible to live and work with vast amounts of highly radioactive substances has already been demonstrated in the plants of the AEC itself. In some of these plants, the workers manipulate safely radioactive material equivalent to thousands of tons of radium. Not only has radiation injury been almost negligible in the atomic energy industry but the climate of radiological safety has resulted in better care with respect to hazards of all kinds so that the safety record of the AEC has merited special recognition. Difficult as the problems are, there is no occasion for fear that this record cannot be continued in the expanding atomic energy industry which may form one of the bases of our industrial and social structures within a comparatively few decades.

Manpower Potentials

PHR brief

Many ways are being developed to overcome the economic barriers to good care which have existed in the past. While the quality and availability of health services is rapidly expanding, however, the population of the United States is growing.

Dynamic forces will increase the demand for health workers in the years ahead.

There are unmet demands today in medical education, public health, mental and tuberculosis hospitals, and rehabilitation. Many rural areas and small towns are in need of practicing physicians. Hospitals in increasing numbers are resorting to the use of alien physicians with training which is less than adequate by our standards for house staff service. A civilian disaster of the magnitude possible today could put an incredible load on the available physicians.

It is often said that areas with lower physician population ratios are not economically in a position to utilize a greater number. However, the fact that in States with the poorest ratios, doctors report the longest workweek averaging 63 hours a week, and the highest average incomes, indicates that the demand for services in many of those areas is placing a heavy strain on the supply.

In dentistry, a parallel problem exists. Training facilities are being expanded. But this increase is not quite keeping up with the population, and by 1965 the ratio of dentists to population will be, we estimate, 57 per 100,000 as compared with 58 per 100,000 today.

The number of graduates of schools of nursing has been stabilized at 28,000 or 29,000 since 1951, but the number of entrants is now rising again.

The shorter patient stays and the emphasis in rehabilitation on getting the patient on his feet and returning him rapidly to a condition of independence all call for new emphasis in nursing care and have resulted in an intensification of nursing activities.

Efforts of the nursing profession to maintain the supply of professional workers and to improve their utilization have been outstanding, and there is indication that the supply situation in nursing is not as critical as it was a few years ago.

One aspect of better utilization is the increased employment of other workers for functions which do not require the nurse's special skills. The trend toward hospital staff nursing and away from private duty nursing means that more nurses are available for hospital employment.

The training of paramedical workers such as physical therapists and occupational therapists is likewise increasing although the numbers of these are still very small. But present levels

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of training are not at all closing the gap between demand and supply.

For each of these professions there are probably over 3,000 vacant positions today.

The demand in these areas is continuing to grow rapidly, and though the supply of graduates is increasing there is every indication that the demand will continue to outrun the supply.

For the Future

This is the time then to take a long look at the educational opportunities which we are prepared to offer, both as to quality and quantity. First, curriculum: Most of the health professions today are looking seriously at their curriculum and weighing it in relation to the total job to be done. They are looking, although perhaps still not sharply enough, at the problem of training the workers in the many disciplines to work together for the patient, to orient their planning and activities so that the best thing is done for the patient rather than the best thing for the individual category of professional worker.

A real bottleneck in education today is salary scales. This is part of a general problem which plagues the Nation, that of obtaining enough teachers and good enough teachers from the kindergarten through the whole educational process.

Getting adequate facilities is another serious hurdle in providing for professional education. Schools of medicine and dentistry and nursing are seriously hampered by lack of facilities. Schools of the paramedical professions also suffer seriously from lack of basic clinical facilities and equipment.

Thus far, however, the attacks on these problems of curriculum, of faculty, and of facilities have been piecemeal and inadequate.

A basic across-the-board necessity is money. Medical schools, dental schools, schools of nursing, and the paramedical sciences are all hampered by lack of adequate funds in carrying out the objectives of their present programs, in recruiting and maintaining staff, in developing programs to meet changing needs, and in providing the best educational environment.

The spirit of rehabilitation is in itself a spirit of dedication to the human welfare and dignity of man, regardless of his physical limitations.

In forecasting America's health, our efforts and the degree of success we achieve in developing improved health for the peoples of the world are a major factor. In our shrinking world of today, our own health—medically, emotionally, economically, and politically—is dependent upon the health of the rest of the world. To achieve that state of health, we could do well to adopt the slogan of an obscure but wise English philosopher who said 300 years ago, "If every man would but mend a man, the world would all be mended."

March of Medical Science

PHR brief

The title of this program, "The March of Medical and Social Sciences," in itself reflects growing awareness that health is an inseparable element in social progress and that medical science does not and cannot function in isolation from the social, economic, educational, and cultural forces in our society.

Research Advances

The problems faced by medical science are tremendous in volume, scope, and complexity. When one looks back at what medical science has accomplished over a span of several decades, he can identify the items quite easily. When one looks at medical science today and tries to pick out the most promising work, he finds the task quite difficult. But when one attempts to anticipate what progress will have been made by, say 1975, his first inclination is to look for

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cover, and his second is to generalize and digress, because the record shows that medical progress is replete with false hopes, pitfalls, and hypotheses that cannot be confirmed. The way to progress is long and difficult, and the specific advances are anticipated only by those who possess temerity and clairvoyance.

It is possible, however, to pick out several broad general areas and to project recent progress for several years, assuming that no new variables are brought into play. I will try to confine my speculations to areas which might have meaning in terms of planning health resources for the future.

It is reasonable to assume that there will be vaccines which will be largely effective in the prevention of influenza, poliomyelitis, and the minor upper respiratory infections, including the common cold.

There could be major advances against heart disease, featuring the prevention of rheumatic heart disease by the prevention of rheumatic fever; drugs to control hypertension; and some as yet unknown means to control the fatty deposits in the blood stream which lead to atherosclerosis.

There will be improvements in cancer diagnosis. Treatment of cancer will improve, too; in addition to X-ray therapy and surgery, there may well be chemical agents of particular value against the soft tumors.

There will be new drugs useful in the management of mental illness. We shall have better knowledge of prevention. But the hard core of the problem of mental illness will remain until training and education begin to yield the professional staffs that are so desperately needed, both to study mental illness and to care for the mentally ill.

There will be a series of new drugs, both natural and synthetic, useful in the treatment of arthritis and other rheumatic diseases.

We shall have the knowledge and methods to prevent several of the leading forms of blindness, particularly among children.

There may be fewer advances in the management of neurological disorders, such as cerebral palsy and muscular dystrophy. However, new rehabilitation techniques are in process which bring some of the victims of these diseases a measure of independent self-care.

The Medical Science Spectrum

As one studies the pattern of research activities in the medical and biological sciences, it becomes apparent that while a great deal of progress is being made toward relief or amelioration of the effects of disease, we are not making the same progress toward understanding of the basic underlying causes of disease. This is particularly true for the chronic illnesses. I raise this point only to emphasize the continuing need for fundamental studies, as distinct from target-applied research, which will yield the knowledge with which we can achieve the ultimate goal—prevention.

By these fundamental studies, I refer, in part, to clinical and laboratory investigations, but I also refer to those studies involving man in his environment, both normal and abnormal. If medical science applies the knowledge and techniques of epidemiology, statistics, economics, sociology, anthropology, and related fields to these fundamental investigations, it may find that such fields have as much potential for identifying the factors in disease causation as the clinical and laboratory studies.

Medical science has concentrated on understanding the nature and modes of action and interaction of progressively smaller things. Not too many decades ago, we were studying functions of whole organs or large sections of tissue. Gradually, we reduce the dimension of our studies to the cellular level. Now we are concerned with subcellular matters. We find that even within the cell, there are relations and interdependencies which materially affect the life processes. Scientists study, for example, the role of cytoplasm in genetics, the ability of viruses to destroy certain cells but live peacefully in others, or the factors that govern cell growth and multiplication.

I do not, of course, challenge the validity of the scientific method which seeks understanding of the processes of health and disease through this microscopic and submicroscopic approach. I stress, rather, that it is time for us to also give emphasis to the study of man as a "supramacroscopic" organism, if you will, and to study the whole man in relation to other men and to the environment in which they live.

By way of illustration, we are now conducting a study of a neurological disease known as amyotropic lateral sclerosis, more commonly called "Lou Gehrig's disease." On the island of Guam, this disease is 50 times more prevalent than it is in the United States. That offers a golden opportunity for an epidemiological study. There is another study in Massachusetts, which has undertaken to follow a large population group in order to investigate and evaluate the factors involved in the development of hypertension and atherosclerosis. The investigators are not only physicians but also epidemiologists, biostatisticians, social workers, nurses, public health workers, industrial physicians, sociologists and psychologists, anthropologists, and historians—all those who can contribute to better understanding of what causes contribute to having or not having heart disease.

No Formula for Progress

Progress in medical science does not come easily. But I am convinced that it will continue in the future as it has in the past, and perhaps more abundantly. We have only to build intelligently on our experience.

The most serious threat to the ability of medical science to do the job it must do is the impending shortage of trained investigators of all kinds. Science teaching in the secondary schools has not kept pace with increasing needs. The preclinical sciences have suffered in the colleges and universities. And there are too few career opportunities in the basic sciences related to medicine and biology. We must do something immediately and constructively to resolve this issue.

Cooperative Effort

Another challenge of medical science is to achieve a more effective linking of institutions and agencies and organizations which together make up the health resources of our Nation.

I do not mean to oversell the value of coordination as such. There are times when I feel we spend so much time coordinating our efforts that the efforts themselves get almost obliterated, and coordination becomes merely entanglement. Cooperation, yes—knowledge of other programs, ability to use them as resources, eagerness to work together where interests merge, respect for the objectives and methods of other groups, desire to avoid jurisdictional disputes— these are the essence of effective cooperation in health and related fields. For example, one city has a single telephone number to answer all health inquiries in order to assure appropriate referral to the proper health agency or agencies.

We need more of this kind of cooperation. For as we get larger and older as a Nation, the health needs of the people grow and the pattern of health services changes to meet these needs.

The General Outlook

Probably the largest single factor to concern those who plan civilian health programs in this country is our changing population.

Heart disease, cancer, mental and neurological disorders, arthritis and various metabolic problems such as diabetes, blindness, and dental disease will reach even greater proportions. The future will bring increased pressures upon society to prevent or cure these chronic diseases, to prolong the usefulness of man throughout the maximum portion of his allotted years.

The emphasis on chronic diseases should not obscure the fact that serious infectious diseases are with us, too—hepatitis, influenza, brucellosis—and that any relaxation of public health vigilance is an invitation for reappearance of smallpox, typhoid fever, and other scourges of the past. This work becomes all the more meaningful when one remembers that certain major chronic diseases may well have their origin in micro-organisms. Witness, for example, the several types of cancer in animals which are known to be caused by viruses.

Another problem for the future rests on the fact that this country has become predominantly urban. This trend increases the burden of State and local health departments to maintain sanitary, healthful conditions for our 160 millions. It brings to the fore such programs as city health planning, air and water pollution, accident prevention, sanitation, and cancer that may be of industrial origin.

I think I should make special mention of two problems of major significance: mental illness

and diseases of aging. Already the mentally ill occupy half of America's hospital beds and cost us well over a billion dollars in tax money alone. And the dimension of the problem is growing by $100 million a year. We must certainly find better preventive methods and more practical and adequate means of treating these unfortunates.

Related problems are juvenile delinquency, drug and alcohol addiction, the gamut of self-injurious and antisocial behavior, to be approached through both the physical and the social sciences.

So we return to my earlier reference on the inseparability of medical and social science. It is all too obvious that we must do something about effective utilization of our older people, reexamining our whole social and economic structure to find ways to help them recapture their place as useful and productive and happy members of society.

Conclusion

In conclusion, this judgment seems germane to the forward march of medical science:

We must move simultaneously toward better application of what we now know about the prevention and control of disease; toward the acquisition of new knowledge; and toward making the necessary changes in today's health structure to be ready for tomorrow's challenges.

Social Processes at Work

PHR brief

Public health workers have two major interests: acquiring new health knowledge and applying known techniques and information. In different words, public health is committed to research and to practice. Social science can aid in both. Examples from psychosomatic medicine, child study, and nutrition will indicate how social science can assist in basic health research.

By Benjamin D. Paul, Ph.D., lecturer on social anthropology, Harvard University.

Health Research

In the field of psychosomatic medicine, social scientists are exploring areas of social strain as possible determinants of ailments such as ulcers. Social mobility is one of the cardinal features of America's open class system. Striving for mobility may bring tangible benefits, but it also generates anxiety, and it is possible to study the role of mobility anxiety in ulcer formation. In recent decades ulcer has increasingly become a man's rather than a woman's disease. This may be related to men's steady loss of social status and security as a result of the ascending social position of women.

Social science is slowly building up information about, and fashioning tools for, studying personality formation. This is an important part of the field of child development, a field in which the health disciplines and the social science disciplines alike have a lively interest. Recently, for instance, Cornell, Harvard, and Yale have begun a joint study of parent-child relationships in five different villages located respectively in India, Okinawa, the Philippines, Mexico, and New England. Using nature's cross-cultural laboratory, this farflung research project is designed to test certain hypotheses concerning child training and its impact on child behavior, adult personality, and cultural values.

Still another example relates to nutritional research. Epidemiological studies and laboratory work have focused attention on the possibly critical role of certain vitamins, amino acids, and antibiotics in promoting normal growth. To test out some of these findings in the field, a nutritional research organization in Central America set up a series of experiments in five local villages. School children in each community were given a different combination of nutrients and food supplements. Periodically the nutritional status of the children was checked through blood sampling and other means. But in one of the vil-

lages the parents threatened to withdraw their children from the program, jeopardizing the conclusiveness of the ultimate research results.

To locate the sources of resistance, an anthropologist was sent into the community. These are some of the things he found out. Project personnel had unwittingly become identified with one of two hostile political factions; this led to the charge that the program was dangerously subversive. A local medical clinic and other services, intended to win village good will and cooperation, were causing more harm than good; they were not adjusted to local expectations. According to their lights, parents saw blood sampling as injurious to their children's health; they regarded blood as a nonregenerative substance. Moreover, they began to spread and credit rumors that the object of feeding children was to fatten them for export to the United States where they would be eaten; they now believed that the purpose of blood taking was to check scientifically whether the children were ready for shipment.

Once the sources of trouble were located, the anthropologist was able to suggest countermeasures to regain the villagers' confidence and allow the research program to run its full course. Here again, social science techniques furthered the cause of health research. However, social scientists are able to contribute even more perhaps to public health practice than to public health research.

Public Health Practice

The practice of public health emphasizes promotive and preventive medicine. Even more distinctively it is concerned with groups, populations, and communities, rather than with individuals in relative isolation. Social scientists by definition are equally concerned with groups and communities, although their primary urge is to acquire knowledge rather than put their knowledge to practical use; by inclination they prefer scholarship to a career of service. Yet their interest in understanding the community attracts them to action programs. By observing how communities respond to service programs they learn how communities work. Health programs in turn can improve their approach by taking advantage of the information the social scientists thus accumulate.

In working with health teams, social scientists probably cannot make their best contributions by engaging in direct service; their training doesn't usually fit them for social work. They can help in program planning, but perhaps their greatest contribution can be made in program assessment.

Assessment of Effect

Suppose a health agency is dedicated to changing a community's health habits. After a period of effort the agency wants to know: Did any change occur? Was the change the one we wanted? Were we the cause of the change?

Social scientists have techniques for supplying the answers. By means of interviews or questionnaires and using proper sampling methods, the health habits of a community are measured before and after the campaign.

In several Syrian villages it was found, for example, that hygienic habits had improved appreciably after 2 years of organized effort. Conceivably the improvement might have come about despite the health campaign and not because of it. Indeed control villages showed similar improvement during the same interval, thus making it difficult for the health workers to claim the credit for the change in their experimental village. We don't really know what happened. The answer would require use of a yardstick that measures process rather than effect alone.

Recently an interdisciplinary team engaged in an intensive campaign to alter attitudes toward the mentally ill in a fairly prosperous domestic community. Team members reasoned that an unfavorable attitude toward discharged mental patients was influencing the high rate of relapse and readmission to overcrowded hospitals. They established themselves in the town, gained the cooperation of influential persons, and used, as means and resources, motion pictures, pamphlets, books placed in the library, newspaper notices, broadcasts, speakers, small group discussions.

Before and after the campaign they collected several hundred questionnaires designed to re-

veal attitudes toward the mentally ill—conceptions of cause, curability, degree of personal responsibility for helping a sick relative, willingness to associate with a person discharged from a mental hospital. They twice administered the same set of tests in another town where no campaign of health education was attempted. As expected, the people there showed no significant change of attitude. But surprisingly, neither did those where the intensive campaign had been tried.

The reasons for this negative outcome were instructive. But to understand the reasons they had to investigate process rather than rest content with measuring effect.

Assessment of Process

In the mental health instance, the processes responsible for the negative outcome could be uncovered by combining various types of evidence, including data from intensive interviews and observed changes in people's reaction to the education and testing team.

One of the ideas the team had sought to communicate was that no sharp line divided the sane from the insane, that personality types fell along a continuum running from the fully normal to the fully abnormal, and that most released hospital patients were therefore not essentially different from other people and should be treated accordingly.

But people in the community clung hard to their black-and-white concept of normality and abnormality. Not always certain about their own sanity, they had erected a wall of defense that sharply divided the sane from the insane. In trying to undermine this popular conception, the educators were apparently arousing deep insecurities. Without good rational defenses against rational argument, the citizens responded by withdrawing their cooperation. They showed outward apathy, attempted to withdraw, and ultimately expressed open hostility toward the project personnel.

The lesson is clear. Before trying to change old health habits and ideas for new, it is wise to ascertain what the established habits and ideas are and what psychological and social functions these beliefs and practices perform. It is in this direction that social scientists can point the way. Ultimately their biggest contribution to health programs may lie in probing beneath cases of success and failure to unravel the hidden processes that are ever at work in the community.

Marshall A. Shaffer, 1899–1955

Marshall A. Shaffer, chief of the Technical Services Branch, Division of Hospital Facilities, Public Health Service, died suddenly on May 25. Mr. Shaffer, internationally recognized for his work, was responsible for the architectural engineering phases of the hospital survey and construction program since its inception. He entered the Public Health Service in 1941 and was commissioned as engineer officer in 1945.

After graduation from Pennsylvania State College in 1922, Mr. Shaffer worked for 11 years as an engineer in Central America, Mexico, and the southwestern United States. During this time he studied and practiced architecture. He worked on the design of the Los Angeles General Hospital, the largest in the world, and won several competition awards. In 1933 he became consulting designer for the Federal Works Agency.

In 1951, Marshall Shaffer was given the American Institute of Architecture's Kemper award for "ensuring the conduct of the hospital building program in harmony with the highest ethical standards." That same year he was invited to represent the United States at the Building Research Congress in London. In 1952, he was a delegate to the Eighth Pan-American Congress of Architecture at Mexico City. At that time, he was elected president of the Plenary Session on Hospitals, the first American to be so honored.

The Internal Revenue Code of 1954 and Health Programs

By SELMA MUSHKIN, M.A.

OF SPECIAL INTEREST to public health personnel are changes in the new Internal Revenue Code of 1954 providing additional tax relief for those who become ill and incur large medical bills. Also of interest are provisions affecting health manpower, training, and research.

The new revenue code was designed primarily to remove inequities, clarify tax law, and bring the provisions of the taxing statutes in line with current economic developments. Although the new tax act involved a tax reduction of $1.4 billion, it was designed as a reform and not a tax reduction measure.

Sick Leave Pay and Medical Costs

Two provisions of the Internal Revenue Code of 1954 are especially notable for their potential impact on health programs and voluntary health insurance. These provisions relate to sick leave pay or temporary disability benefits and the tax deduction allowed for medical expenses.

Employer Sickness Benefit Plans

In the last decade employer participation in employee health and welfare plans has expanded considerably. A combination of factors has stimulated employer interest in health plans. Increased recognition of such plans as an integral part of the labor-management programs, union emphasis on this form of protection in collective bargaining, the exemption of these plan benefits from restrictions of the wage stabilization program, and the indirect incentive of the excess profits tax have all contributed to this growth.

It has been estimated that employer contributions toward pension, health, and welfare plans reached $5 billion in 1953 (*1*) and that employer contributions for health insurance plans alone exceeded $750 million (*2*).

Considerable uncertainty developed under the earlier revenue laws concerning the tax liability of employer contributions toward sickness and health insurance of their employees. For some time before the enactment of the code of 1954, changes in Internal Revenue Service regulations were under discussion to clarify the employees' tax liability for these health and sickness insurance premiums. The new code specifies that premiums and contributions paid by employers under a plan to finance sickness and accident benefits are not currently taxed as employee income. Furthermore, employer payments and premiums to reimburse an employee for expenses incurred for the medical care of the employee, his spouse, and dependents are tax exempt, provided the employee does not claim a medical expense deduction for such expenses under his individual income tax.

Uncertainty also developed concerning the

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taxability of sickness benefits received by employees under plans operated by their employers (*3*). In general, amounts received as accident or cash sickness benefits were excluded from gross income under the earlier statutes and regulations, if the benefits were paid under an insurance contract. Benefits financed by an employer under a self-insured plan or a wage continuation plan were taxable. In the words of the Ways and Means Committee of the House of Representatives: "Very troublesome legal and administrative problems have arisen in determining whether particular plans, especially self-insured plans, which are financed by employers without the use of a carrier or insurance company, constitute insurance for purposes of the exemption" (*4*).

Although employer sickness benefit plans (including sick leave provisions for government employees) go back many years, provision of cash sickness benefits was stimulated considerably by the enactment of State temporary disability benefit laws, the Federal railroad cash sickness benefit provisions, and by collective bargaining agreements. Rhode Island adopted the first State temporary disability program in 1942. California, New Jersey, and New York also have enacted temporary disability statutes. In these three States, unlike Rhode Island, the benefits may be paid either from a State fund or under a private plan which conforms with State law. An approved private plan in these three States may be set up either in the form of a contract with an insurance carrier or on a self-insurance basis satisfactory to the States (*5*).

In 1953, cash sickness benefits under State law totaled $231.8 million. Of this total some $140 million was paid out through private plans, including about 8–10 percent which was paid out under self-insured plans. It has been estimated, furthermore, that in 1953 approximately $975 million was paid in premiums for private insurance against loss of income during sickness, and the benefits paid out under this insurance amounted to about 60 percent of the premiums, or $600 million (*6*). While there are no adequate current data on employer participation in the payment of these premiums, it has been estimated that employers are financing about 45 percent of the premiums paid.

In general, the new revenue code narrows the exemptions of these sickness benefits from taxable income by imposing a limitation on the maximum amount of sickness payments financed by employers which may be excluded from income. In testifying on the new revenue code, for example, Marion B. Folsom, Under Secretary of the Treasury, stated: "When the present law was put into effect giving tax exemption status to sick benefit payments under insured plans, very few insurance companies would write policies providing more than $50 or $75 a week benefits. But, in recent years they have cut off the maximum and now some of these insured plans provide almost unlimited benefits when people are out sick, for executives, as well as the rank and file. Under the present law, that is all tax exempt. Under our proposal, we would put a ceiling of $100 a week on tax exemptions of any sick benefit plan" (*7*).

The new code clearly excludes from gross income the benefits an employee receives under a workmen's compensation act for sickness or accident incurred in the course of employment. It also excludes compensation paid under a workmen's compensation act to the survivors of a deceased employee. Similarly, damages received on account of personal injury or sickness (whether by suit or agreement) are clearly excluded. Full exemption is also granted for payments received for the permanent loss or loss of use of a member or function of the body or the permanent disfigurement of the employee, his spouse, or dependent provided such payments are not a continuation of wages for the period an employee is absent from work (*8*).

Payments received by an employee under an accident or cash sickness plan for wage loss resulting from illness or injury are exempt up to a weekly rate of $100. However, such payments received during the first 7 days of illness are exempted from taxation only if the employee is hospitalized for at least one day during the period of illness. When the absence is caused by injury or accident there is no waiting period.

The exclusion from income, while narrowed for those receiving benefits under plans carried by insurance companies, is broadened to include payments under a self-insured plan and

amounts received as wages or in lieu of wages during a period of sickness. These payments, previously taxable, are now exempt within the $100 weekly maximum to the extent they are employer financed. In general, the provisions of the new code follow the practices of many commercial insurance policies in length of waiting periods, in differentiating between hospitalized illnesses and other illnesses, and in distinguishing between accidental and other disabilities. The new tax provisions add another incentive to hospitalization and raise many complex problems similar to those involved in the administration of sickness benefit payments.

A notice of proposed regulations under the accident and sickness benefit provisions of the new code was released in the Federal Register on March 24, 1955. These regulations set forth rules for determining the amount of benefits attributable to employer contributions in cases in which contributory and noncontributory plans are combined. They clarify the basis of differentiating payments which are related to a period of work absence from other disability benefits. The regulations also spell out the rules for determining the proportion of wages which may be excluded under wage continuation plans, by defining both the basis for determining the weekly rate of pay and the period during which income attributable to illness may be excluded.

If the amount of wages or benefits received does not exceed $100 a week, the full amount of the payment after the waiting period may be excluded from gross income without regard to the number of additional days of absence from work. If the wages exceed $100 a week, the payment during the period of illness is prorated in proportion to the $100 weekly maximum. For example, an employee earns $120 a week. He is ill for the waiting period and an additional 3 days. He receives a total of $192 during the period of illness. The $120 pay for the first week would be counted as income. Sixty dollars of the additional $72 in wages received for the 3 days of additional absence would be excluded from the employee's gross income. In other words, the exclusion would be in the ratio that the $100 maximum is to the weekly wage of $120.

Among the various problems of definition and interpretation in the new tax provisions is that of the definition of illness. The Internal Revenue Service under a recent ruling, for example, has determined that "payments received for a period of absence due solely to pregnancy may not be excluded from gross income. Pay for time missed for actual sickness during a pregnancy whether or not a result of the pregnancy, however, would be an exempt income amount."

It may be of interest to note that a provision of the new revenue code is especially addressed to the problem of equalizing the tax treatment of retirement pay on account of service-connected disabilities of the commissioned officers of the Public Health Service and of the Coast and Geodetic Survey with those of members of the armed services. For all these groups such payments are exempted from taxable income.

Medical Expense Deductions

A deduction for medical care expenses in excess of 5 percent of income was first introduced in 1942 along with the wartime increases in individual income taxes and reductions in personal exemptions. The Senate Finance Committee, in approving the deduction in that year, reported that "This allowance is recommended in consideration of the heavy tax burden that must be borne by individuals during the existing emergency and of the desirability of maintaining the present high level of public health and morale" (*9*). The deduction was modified by subsequent revenue acts. In 1944, the lower limit was changed from 5 percent of net income to 5 percent of adjusted gross income, that is, income before exemptions and allowed nonbusiness deductions. Other revenue acts raised the maximum amount of the deduction. A significant change was made by the Revenue Act of 1951 which permitted taxpayers 65 years of age and over to deduct medical expenses for themselves and their spouses without regard to the 5 percent of income minimum.

The new code makes three major changes in the medical care expense deduction. It allows deduction of medical expenses in excess of 3 percent instead of 5 percent of adjusted gross income. It limits the amount of drugs and medicine which may be included in medical care

Table 1. Number of taxable income tax returns with medical and dental deductions and amount of such deductions, 1950

Adjusted gross income classes	Number of tax returns (thousands)	Adjusted gross income reported (millions)	Medical and dental deductions (millions)	Medical and dental deductions plus 5 percent of adjusted gross income		
				Amount (millions)	Percent of adjusted gross income	Average amount per return
Total	4, 138	$17, 766	$1, 260	$2, 148	12. 1	$519
Under $1,000	40	36	4	6	16. 7	150
$1,000–$1,999	416	664	75	108	16. 3	260
$2,000–$2,999	818	2, 068	191	294	14. 2	359
$3,000–$3,999	1, 113	3, 890	295	489	12. 6	439
$4,000–$4,999	798	3, 551	236	414	11. 7	519
$5,000–$6,999	656	3, 786	233	422	11. 1	643
$7,000–$9,999	170	1, 372	97	166	12. 1	976
$10,000–$14,999	70	835	57	99	11. 9	1, 414
$15,000–$24,999	37	697	41	76	10. 9	2, 054
$25,000–$49,999	16	547	24	51	9. 3	3, 188
$50,000–$99,999	3	222	6	17	7. 7	5, 667
$100,000 and over	1	97	1	6	6. 2	6, 000

SOURCE: Data from the Internal Revenue Service.

expenses to sums in excess of 1 percent of income.

For example, a family with an adjusted gross income of $5,000 may deduct medical expenses above $150 instead of the amount in excess of $250 previously allowed. However, this family can include in the deduction only the amount above $50 that they paid for drugs and medicine. The maximum allowable deduction for medical expenses is increased from $1,250 to $2,500 per exemption. The overall limit per tax return for a married couple filing a joint return or a head of a household has been increased from $5,000 to $10,000. For a single person filing a return or married persons filing separately the maximum limit is raised from $2,500 to $5,000.

Other changes in the medical care deductions are also made by the new code. A new provision allows the expenses of a last illness to be deducted on the final return of a decedent, even if the expenses are paid after death. The definition of medical expenses is clarified by providing for the deduction of amounts paid for accident or health insurance and transportation expenses for travel prescribed for health reasons. Expenses for food and lodging during such travel are not deductible.

The Department of the Treasury at the time of the hearings on the new revenue act estimated that about 8.5 million taxpayers would receive additional tax relief as a consequence of the changes in the medical care deductions and that the net cost to the Government in the form of tax loss would be about $80 million.

In assessing the importance of the change in the medical care deduction provision, it is important to take account of the population represented on tax returns and the extent to which even large medical care bills fall within the limits of the so-called standard deduction option provided for all taxpayers (*10, 11*). An estimated 55 to 60 million tax returns were filed for the 1954 income year—80–85 percent estimated as taxable. The population represented on taxable returns has been estimated at between 65 and 70 percent of the total population. Those not taxable include, among others, persons drawing on their capital and assets for current living expenses, those with income less than $600 per person supported by the family head, and those receiving a large portion of their income from nontaxable sources such as public payments and contributory annuities.

Even among the taxpaying group, however, a standard deduction is used far more frequently than are itemized deductions. The standard deduction, written into tax laws to

simplify administration, authorizes an average amount of deduction for all taxpayers for the deductible items of expenses—such as charitable contributions, property taxes, interest on indebtedness, and medical expenses. The standard deduction amounts to 10 percent of adjusted gross income, up to $1,000 ($500 for spouses filing separate returns). Accordingly, those with no deductions other than medical care costs—even costs amounting to as much as 15 percent of income—would tend, because of the greater simplicity, to use a standard deduction. Despite this fact, in 1950, the last year for which complete tabulated data are available, some 4 million taxpayers itemized their medical care deductions. In the aggregate, medical expenses of these taxpayers exceeded $2 billion, or over $500 per tax return. The amount of medical and dental deductions totaled $1.3 billion (table 1). Almost half of the approximately 8.5 million taxpayers who itemized their deductions, instead of claiming a standard deduction, reported medical expenses in excess of 5 percent of income (table 2). The variation in the amount of average medical care expenses per return by income group and the percent of income spent for medical care are shown in tables 1 and 2. Table 3 indicates the proportion of total returns whether taxable or not which reported medical and dental deductions for that year and the amount of these deductions by income groups.

The data derived in the operation of the revenue act may be compared with data available on the distribution of medical care costs for all families in the population. The Health Information Foundation, for example, in its recent study of voluntary health insurance and consumer expenditures for personal health services in the period 1952–53, found that 7 percent of all families—approximately 3.5 million—incurred medical care expenses in excess of $495. Approximately 1 million families incurred medical care expenses equalling or exceeding one-half of their annual incomes, and about 500,000 families incurred medical expenses equalling or exceeding their annual income (*12*).

The national bill for medical care expenses in 1953 was approximately $10 billion, or about 4 percent of personal income after taxes. The total by class of service as estimated by the Social Security Administration is shown in table 4.

During the course of the hearings on the change in the medical care expense deductions much testimony was offered on the need for special tax provision to give taxpayers incen-

Table 2. Taxable returns with itemized deductions, all types of deductions and deductions for medical and dental expense, 1950

Adjusted income	Taxable returns with itemized deductions		Returns with medical expense deduction		
	Number (thousands)	Percent all taxable returns	Number (thousands)	Percent all taxable returns	Percent itemized taxable returns
Total	8,724	22.85	4,138	10.84	47.43
Under $1,000	77	4.90	40	2.55	51.95
$1,000–$1,999	710	11.84	416	6.94	58.59
$2,000–$2,999	1,443	16.55	818	9.38	56.69
$3,000–$3,999	2,082	24.02	1,113	12.84	53.46
$4,000–$4,999	1,653	28.80	798	13.90	48.28
$5,000–$6,999	1,556	34.21	656	14.42	42.16
$7,000–$9,999	488	31.16	170	10.86	34.84
$10,000–$14,999	257	37.85	70	10.31	27.24
$15,000–$24,999	220	55.56	37	9.34	16.82
$25,000–$49,999	163	74.09	16	7.27	9.82
$50,000–$99,999	56	88.89	3	4.76	5.36
$100,000 and over	19	95.00	1	5.00	5.26

SOURCE: Data from the Internal Revenue Service.

Table 3. Number and percent of income tax returns with medical and dental deductions, and amount of such deductions compared with adjusted gross income, by income class, 1950

Adjusted gross income classes [1]	Number of individual tax returns			Returns with medical and dental deductions [2]		
	Total (thousands)	With medical and dental deductions		Adjusted gross income reported on returns with medical deductions (millions)	Medical and dental deductions	
		Number (thousands)	Percent of total [3]		Amount [4] (millions)	Percent of adjusted gross income [4]
Total	53, 060	4, 859	9. 2	[5] $19, 397	$1, 560	8. 0
No adjusted gross income	404	8	1. 9	[6] 32	4	12. 8
Under $1,000 [7]	7, 362	122	1. 7	98	27	27. 6
$1,000–$1,999	10, 550	642	6. 1	1, 006	159	15. 8
$2,000–$2,999	11, 429	1, 040	9. 1	2, 613	280	10. 7
$3,000–$3,999	9, 837	1, 238	12. 6	4, 319	353	8. 2
$4,000–$4,999	5, 985	857	14. 3	3, 834	278	7. 3
$5,000–$6,999	4, 549	656	14. 4	3, 786	233	6. 2
$7,000–$9,999	1, 566	170	10. 8	1, 372	97	7. 1
$10,000–$14,999	679	69	10. 2	835	57	6. 8
$15,000–$24,999	396	37	9. 4	697	41	5. 8
$25,000–$49,999	220	16	7. 5	547	24	4. 3
$50,000–$99,999	63	3	5. 4	223	6	2. 8
$100,000 and over	20	1	3. 1	97	1	1. 4

[1] Adjusted gross income means gross income minus allowable trade and business deductions, expenses of travel and lodging in connection with employment, reimbursed expenses in connection with employment, deductions attributable to rents and royalties, certain deductions of life tenants and income beneficiaries of property held in trust, and allowable losses from sales or exchanges of property. Should these allowable deductions exceed the gross income, there is an adjusted gross deficit. The adjusted gross income classes are based on the amount of adjusted gross income, except that returns with adjusted gross deficit are designated "no adjusted gross income" without regard to the amount.

[2] Medical and dental expenses, reported on returns with itemized deductions, paid for the care of the taxpayer, his spouse, or dependents, not compensated by insurance or otherwise, which exceed 5 percent of the adjusted gross income. The deduction in 1950 could not exceed $1,250 multiplied by the number of exemptions other than those for age and blindness with a maximum deduction of $2,500, except on a joint return of husband and wife the maximum was $5,000.

[3] Percentages based on unrounded numbers of tax returns and dollar amounts in thousands.

[4] Reported on returns with medical deductions. Does not include nondeductible medical expenses equal to 5 percent of adjusted gross income.

[5] Adjusted gross income less adjusted gross deficit.

[6] Adjusted gross deficit.

[7] Persons with gross incomes below $600 are not required to file returns. However, many such persons do file returns, chiefly for the purpose of claiming refunds of tax prepayments; and those returns are included in the tabulation.

SOURCE: Data from the Internal Revenue Service.

tives for purchasing voluntary health insurance protection against large medical bills. At present, premiums paid for voluntary health insurance may be included as a medical care expense, but there is no special tax incentive for the purchase of this protection.

The American Hospital Association, through its Council on Government Relations, made known its view at the time of the hearings on the new revenue act. In a letter to the chairman of the Ways and Means Committee these views were stated as follows: "Hospitals recognize that many hospital and medical expenses that impose severe financial burdens upon families and individuals are not deductible because they do not exceed 5 percent of income. Where an extensive illness occurs, it often seems that the maximum of $1,250 hurts most the people who most need this help. But the problem cannot be solved by removing all limits. There are some economic implications in any complete removal of limitations which ought to be explored by the committee. As limits are lowered, there will be more deductions claimed and there

may need to be closer scrutiny of the nature and propriety of these deductions. Not all minor medical expenses are a handicap to income earning, and there is much to be said for limiting this form of relief to catastrophic situations, where these can be defined. . . . The American Hospital Association would generally favor (1) allowing the cost of voluntary health insurance to be deducted from taxable income without regard to fixed minimum percentage of income, and (2) some liberalization in medical expense deductions" (*13a*).

Health Manpower, Training and Research

The new revenue code contains a number of provisions affecting training and research expenditures. Among these provisions are the broadened definition of dependents, the clarification of the tax status of scholarships and fellowships, the liberalized deductions for contributions to hospitals and educational institutions, and special deductions for care of dependents.

Definition of Dependents

Although the Congress rejected proposals for tax deductions for higher education expenses, the new revenue code gives some recognition to the costs to parents of financing students through long periods of academic training and to the current levels of even sporadic earnings of full-time students. The American Council on Education, in testifying before the Ways and Means Committee, described the problems imposed by the earlier revenue provisions as follows: "It means that hundreds of thousands of students spend a considerable portion of their free time in enforced idleness. It places heavy financial burdens on their parents at a time when they can least afford to meet them. It makes it impossible for many poor, but worthy students, to attend institutions of higher learning because of the monetary limitation" (*13b*).

Before the enactment of the code of 1954, a $600 exemption was granted a taxpayer for a dependent if the dependent had a gross income of less than $600 a year. The new revenue act liberalizes this provision by permitting children to be counted as dependents for purposes of exemptions even though they earn income in excess of $600 a year. The children for whom an exemption may be claimed must be under the age of 19 or full-time students at an educational institution. Moreover in determining whether an exemption may be claimed for a child—that is in determining whether the taxpayer provides half or more of the support of the child—the new code permits any scholarships received for study at an educational institution to be ignored in applying the support test.

The problem of dependency credits for students attending medical or dental schools is especially significant because of the extended period and high cost of training and the proportion of students who work. Counts and Stalnaker, in a recent study on the cost of attending medical school, point out that, on the average, students spend $1,500 a year in addition to tuition and fees. Tuition at the schools included in their special study averaged (median value) $800, making the total cost for a student year about $2,300—or a total cost of $9,200 for the completion of 4 years of medical training. Counts and Stalnaker found in their questionnaire survey of 6,251 medical students from 26 selected medical schools that parents were the most important source of income for the majority of students. Approximately 59 percent of the students financed their way by help (other

Table 4. Private expenditures for medical care, 1950 and 1953 [1]

[In millions]

Item	1950	1953
Total	$8,117	$9,866
Hospital services	2,121	2,825
Physicians' services	2,467	2,859
Dentists' services	869	943
Other professional services	476	562
Medicine and appliances	1,885	2,192
Administrative and other net costs of medical care insurance	299	485
Insurance for hospital services	189	284
Insurance for physicians' services	110	201

[1] Based on data from Department of Commerce, 1954 National Income Supplement to Survey of Current Business. Excludes public expenditures for medical care and direct expenditures for nonhospital services by philanthropic organizations. Includes industrial expenditures for health insurance.

SOURCE: Voluntary insurance against sickness; 1948–53 estimates. Social Security Bulletin 17: 5, December 1954.

than loans) from parents. The median amount of income from parents was $1,300 (*14*).

About 3 out of each 4 students reported income from vacation earnings, the median amount being $550. In addition, about one-fourth of the students were employed other than during vacations and received cash payments for their work. A few of the students received services such as board, room, or laundry. Although some of the students were employed at the university where they were attending medical school, the majority had jobs outside the medical school. The median amount of earnings—other than vacation earnings—was $450.

Parents of medical or dental students who are providing half or more of the support of their children will now be permitted to claim the student for purposes of personal exemption even though he earns more than $600 a year. Although the student would be required to file a return, he could also claim a personal exemption of $600. At the lowest income tax bracket, this change would mean a tax saving to the parent of $120 a year. The reported income for parents in the study just cited averaged approximately $7,000, which might make the average tax saving somewhat higher (*14*).

Scholarships and Fellowships

Under earlier tax law there was no special provision regarding the treatment of scholarships and fellowships. The basic ruling of the Internal Revenue Service stated that the amount of a grant or fellowship was includible in gross income unless it could be established to be a gift. The ruling created considerable ambiguity.

The 1954 revenue bill adopted by the House of Representatives excluded scholarships or Federal grants from gross income, but severely limited the types of grants which could be excluded. For example, the House bill specified that postdoctoral fellowships and scholarships could be excluded only if the annual amount of the grant, plus any compensation received from a previous employer, was less than 75 percent of the recipient's earnings in the year preceding the grant.

The American Cancer Society, through its executive vice president, testified that under earlier law their fellowship stipends were ruled by the Internal Revenue Service to be gifts. Although they were not taxable earlier, under the bill as passed by the House the stipends granted by the American Cancer Society would have become taxable because the minimum grants were usually more than 75 percent of the prefellowship earnings. The Senate committee, to take account of the problems raised, adopted an exclusion of $300 per month of postdoctoral grants as a substitute for the 75 percent rule in the House bill.

The new revenue code excludes scholarship and fellowship grants from gross income with certain limitations. The exclusion extends to the value of services and accommodations, such as room, board, and laundry, which are received as part of the grant. It also extends to the amount received for travel, research, clinical assistants, or equipment to the extent that the sums are spent for these purposes.

The exclusion of grants to candidates for degrees does not apply to that portion of any amount received which represents payment for teaching, research, or other services in the nature of part-time employment required as a condition for receiving the grant. However, services required for all candidates for a particular degree are not to be considered part-time employment. For individuals who are not candidates for degrees, such as those receiving postdoctoral fellowships, the exclusion is limited to $300 a month for a maximum period of 36 months. Moreover, the grant may be excluded only if the grantor is a tax exempt organization or a Government agency.

The National Institutes of Health has prepared a summary statement on Public Health Service research fellowships for persons interested in applying for these fellowships. The provisions of the Internal Revenue Code of 1954 as they relate to fellowship awards are included in this summary statement (*15*). In general, postdoctoral awards would not be taxable under the new code because the amount of the awards is below the $300 a month maximum.

Charitable Contributions

The principle of providing an incentive to taxpayers to contribute to charitable causes has long been recognized in income-tax law. In

1952 the maximum allowed deduction for total charitable contributions was raised from 15 to 20 percent of income. The 1954 revenue code allows this limit to be exceeded to the extent that this excess represents contributions to hospitals, educational institutions, or churches. However, this excess may itself in the aggregate not exceed 10 percent of adjusted gross income. In addition, corporations that are limited in their deductions for charitable contributions to 5 percent of taxable income may carry over to the succeeding 2 taxable years any contributions in excess of the 5-percent limit.

In explanation of the changes, the House Ways and Means Committee reported: "This amendment by your committee is designed to aid these institutions in obtaining the additional funds they need in view of their rising costs and the relatively low rate of return they are receiving on endowment funds" (*4a*).

A number of groups appeared in support of continued Federal recognition of the role of voluntary nonprofit health organizations and education institutions through provision by the tax deductions of incentives to contribute to charitable causes.

Child Care Expenses

During the course of consideration by the House Ways and Means Committee of deductions for child care, the American Nurses Association presented its position in support of allowing working women to deduct the amount spent for child care for income tax purposes. In the course of the testimony Julia Thompson, representing the American Nurses Association, indicated that approximately 20 percent of the Nation's 335,000 active nurses would be immediately affected by this legislation. Miss Thompson also pointed out that of the 220,000 inactive nurses, approximately 58 percent have dependents under 18 years of age.

"The American Nurses Association believes that there are many of these inactive nurses—highly trained women greatly needed in hospitals and health agencies—who are willing and able to take nursing jobs but cannot do so because they will not earn enough to pay for help to take care of their children while they work. . . . It would seem that the proposed amendment to the Internal Revenue Code would help relieve the situation by enabling inactive nurses with children to return to their profession on an economical basis" (*13c*). Dr. William S. McNary of the American Hospital Association, in a letter to the chairman of the committee, also indicated the potential effect of the income tax change on hospital manpower resources.

In recognition of the special problems of expenses for child care a new deduction was introduced by the 1954 revenue code. A deduction up to $600 is allowed for expenses paid by a workingwoman or widow for the care of a dependent child or stepchild under 12 years of age or for the care of any dependent who is physically or mentally incapable of caring for himself. The care must be for the purpose of enabling the taxpayer to be employed.

The deduction is limited, moreover, in the case of a working wife. In such cases the deduction is allowed only if she files a joint return with her husband, and the deduction is reduced by the amount by which the combined adjusted gross income of both husband and wife exceeds $4,500, except where the husband is incapable of self-support because physically or mentally incapacitated.

The revenue bill as it passed the House restricted the allowable deduction of workingwomen to widows or those with incapacitated husbands and to expenses for the care of a child under 10 years of age. Various groups testified before the Senate Finance Committee on the need for liberalization of the deduction. Among those supporting liberalization were the United Cerebral Palsy Association and Dr. George G. Deaner of the Institute of Physical Medicine and Rehabilitation. The Senate Finance Committee, in reporting out changes in the House bill which were later voted by the Senate and accepted by the Conference Committee, stated: "Your committee's action in extending the deduction recognizes that similar financial problems may be incurred by taxpayers who, if they are to be gainfully employed, must provide care for physically or mentally incapacitated dependents other than their children. Moreover, it is recognized that in many low-income families, the earnings of the mother are essential for the maintenance of minimum living standards, even where the

father is also employed, and that in such situations the requirement for providing child care may be just as pressing as in the case of a widowed or divorced mother" (*16*).

Definition Problems Ahead

This brief summary of selected provisions of the new revenue code suggests the number and variety of health and medical care questions on which tax decisions will be required. Earlier revenue statutes involved determinations of medical care cost items—what types of expenses are medical care expenses and which of the expenses fall outside of medical care costs. The extra personal exemption for the blind necessitated definitions of blindness.

The new code, however, goes further in the direction of tax relief for hardship cases involving disability and illness. Many additional questions of definition are involved. The new tax deduction provisions for employer-financed compensation for injuries or sickness require differentiation of payments for permanent injury and wage continuation payments for illness. They also require definition, for example, of "permanent loss or loss of use of a member or function of the body," of "sickness," of a period of hospitalization and of continuous illness. The new deduction for expenses for care of dependents requires differentiation of expenses for "drugs and medicine" from other medical care costs as well as definition of "drugs and medicine." The additional deduction for designated types of charitable contributions requires definition of a "hospital." Problems of definition are currently being explored by the Internal Revenue Service, and clarifying regulations are being issued from time to time. Determinations in application of these definitions to individual cases will be the task of that administrative agency in the period ahead.

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The American Diabetes Association

By JOHN A. REED, M.D.

PROFESSIONAL education, patient education, public education and case finding, and research are the four major interests of the American Diabetes Association, which was established and incorporated as a medical organization in 1940. The association is a nonprofit membership organization and the only national nongovernment or voluntary group in the field of diabetes in the United States.

During its early years, the American Diabetes Association was concerned largely with clinical investigation and basic research pertaining to the problems of diabetes mellitus. Recently, however, it has carried out many of the functions of a voluntary health agency, although it has maintained its identity in structure as a medical organization.

The broad objectives of the association, in the language of its constitution and bylaws, are "to further the general welfare through acquisition and dissemination of useful and accurate knowledge and information regarding diabetes mellitus and to undertake in the public interest such activities as will improve the physical welfare of persons having that disorder." To these ends, the association strives:

Dr. Reed, who served for 6 years as secretary of the American Diabetes Association, was elected second vice president of the association in June 1955. He is also an assistant clinical professor of medicine, George Washington University School of Medicine, and has served as a member of the National Advisory Arthritis and Metabolic Disease Council, National Institutes of Health, Public Health Service.

- To promote among physicians and others the free exchange of knowledge with respect to diabetes mellitus.
- To improve the standards of treatment.
- To promote medical research by individuals, hospitals, clinics, universities, and other institutions.
- To educate the public in the early recognition of the disease and in the importance of medical supervision of its treatment.
- To distribute accurate information to the general public by literature, meetings, and other appropriate means.
- To develop educational methods designed to give diabetic patients a better understanding of their disease.
- To encourage the formation of subsidiary groups which will cooperate actively with the association in its program.

The active membership of the association consists of about 2,000 physicians and persons in related scientific fields whose primary interest is in diabetes mellitus. In addition, there are associate, honorary, and corporate members, who assist in the organization's work but are not entitled to vote.

The affairs of the association are managed by a council, which is composed of 18 persons elected by and from the active membership, the 5 principal officers of the association, and the 3 most recent living past presidents.

Financial support for the organization comes from membership dues; self-supporting projects, such as a professional journal, a magazine for diabetic patients, and a series of postgraduate courses; voluntary contributions by individuals, primarily diabetic patients; and

grants by corporations and foundations. The association does not engage in any general public fund-raising compaigns.

Public Education and Case Finding

Education of the public concerning the prevalence of diabetes mellitus and the necessity for early discovery of the disease is of major importance. The number of diabetic patients now under medical care has been estimated to be well over one million, and there is probably an almost equal number of persons who have the disease but are unaware of it. Diabetes stands eighth in the list of known causes of death.

A program of public education and case finding, known as the diabetes detection drive, was established about 7 years ago for the purpose of finding persons with undetected diabetes. The drive is directed through local affiliates of the American Diabetes Association and the committees on diabetes of county and State medical societies, with assistance from public health groups and various local organizations. Activities are conducted throughout the year, but the greatest effort is made in observance of Diabetes Week, which is the third week of November.

The American Diabetes Association uses all mass communications media to focus the attention of the public on the detection drive, while the local affiliates and the committees on diabetes of county and State medical societies obtain the support of newspapers and radio and television stations in their areas.

Any public or voluntary health group which desires to cooperate in the diabetes detection drive, and especially in Diabetes Week activities, may do so through a local affiliate of the ADA. In areas where there is no ADA affiliate, proposed plans may be channeled through the committee on diabetes of the county or State medical society, which, in the absence of an ADA affiliate, assumes full responsibility for the drive. Many health departments, of course, are also undertaking diabetes detection programs.

Other ADA activities in public education include the showing of an exhibit entitled, "What is Diabetes?" This exhibit, which was prepared by the association in 1954, has already been shown at county fairs and medical centers in 17 cities. Ten sets of the exhibit are now in circulation.

Professional Education

Although the American Diabetes Association is one of the younger medical groups, it already has developed a broad program of professional education for its members. This program includes annual scientific meetings; an annual postgraduate course in diabetes and basic metabolic problems; publication of the monthly professional journal *Diabetes;* publication of the Diabetes Guide Book for the Physician, of which more than 150,000 copies have been distributed; preparation and showing of exhibits; and community meetings of the physician membership of the local affiliates.

The postgraduate course, which has been offered yearly since 1953, provides refresher and review training for persons engaged in the clinical practice of diabetes mellitus and for those preparing for American Board of Internal Medicine examinations. The American Academy of General Practice allows 20 hours of postgraduate credit to persons who attend the course. The course is under the direction of the association, and the faculty consists of outstanding men in the fields of clinical metabolism and experimental metabolism. The third in the series was presented January 19 through 21, 1955, at the Lankenau Hospital, Philadelphia.

To date, the association has prepared three exhibits for use in professional education: "Diabetes Detection by the Physician," "Vascular Complications of Diabetes," and "Management of Diabetes Mellitus." These are shown regularly at the annual meetings of the American Medical Association and the American Academy of General Practice, and at State and regional medical meetings throughout the United States.

Patient Education

Patient education is a phase of the association's program which is almost limitless in its

scope. One of its most far-reaching activities is the publication of a bimonthly magazine for diabetic patients, the *ADA Forecast*, which is now 8 years old. Written and edited for diabetic patients, it contains contributions by medical authorities and many articles by patients themselves. In response to requests from patients and their families, reprints have been made available of a large number of informative articles selected from back issues of the publication.

Answering inquiries from diabetic patients and their families is another activity of importance. Each year, the association receives several thousand letters asking questions about diabetes mellitus. Some can be answered with printed materials, but those asking specific questions receive the careful attention of competent medical men.

For use in teaching diabetic patients about their ailment and its control, the association has cooperated with the Public Health Service in producing an audiovisual kit. Also, it has cooperated with the Public Health Service and the American Dietetic Association in the publication of food exchange pamphlets and food lists for use by patients.

The ADA Committee on Employment has set up standards of employment for persons with diabetes. These standards have been of considerable value to employers and patients alike.

In addition to these activities, many of the local affiliates have formed societies of laymen for the purpose of providing mass instruction and general discussion on diabetes for patients and other interested persons.

Research

Through special gifts and grants, research funds have been established for the purpose of widening the knowledge of diabetes mellitus and its control. At the present time, the research program is limited to the granting of fellowships. Dr. Charles H. Best, co-discoverer of insulin, is chairman of the association's Committee on Research and Fellowships, which includes eight eminent investigators and clinicians.

Affiliate Diabetes Associations

To assist the American Diabetes Association in fulfilling its objectives, local affiliate units have been established throughout the United States. As of June 5, 1955, there were 39 such affiliates. Each of these has a clinical society, and many of them also have lay societies composed of diabetic patients, their relatives, and their friends.

The members of the committee on diabetes of the county or State medical society are usually members, and sometimes officers, of the local affiliate. In fact, before an affiliate of the American Diabetes Association is formed, prior official endorsement must be obtained from the appropriate medical society through its committee on diabetes. This close cooperative effort provides a firm foundation on which to build an affiliate.

The affiliate serves the community by bringing together the physicians who are primarily interested in the disorder and the diabetic patients, their families, and their friends.

In order to strengthen the ties between the national organization and the affiliate, the council of the ADA has set up a Board of Governors, composed of a representative from almost each State and two from some of the larger ones. The governor functions as a liaison between the national organization and the local groups. He will participate in the development of all phases of the ADA program, particularly the strengthening of existing affiliates and the formation of new ones. Because of his awareness of the local situations, the governor is in an excellent position to serve in the capacity of adviser.

The governor also serves as senior delegate from his respective State to the ADA Assembly of Delegates, which is an advisory body to the ADA Council. Each affiliate also elects one physician and one layman, if there is a lay society, to the Assembly of Delegates.

One of the projects of great interest in the affiliates is the support of camps for diabetic children. At the present time, there are 24 such camps, most of which are owned or sponsored by affiliates. These camps afford opportunities to educate the children in the maintenance of proper control of their condition, as

well as to provide for them ordinary camping experiences. The affiliates also promote professional and nonprofessional education in diabetes in their own communities through lectures and public forums, and they are a major force in the conduct of the annual diabetes detection drive.

Toward Early Control

Because of the degenerative complications which develop in a high percentage of diabetic patients, it is of utmost importance that control of the disease be established early and maintained. It is generally accepted that good chemical control of the disease prevents the disabling complications to a great extent. With proper treatment, a person with diabetes can work efficiently and with no more loss of time from the job than a person who does not have this ailment. It has been estimated that there are now nearly 200,000 diabetic patients in the labor force.

Diet is the essential part of control, but insulin in addition to diet is necessary in about 50 to 75 percent of the cases. Through close cooperation between the patient and the physician, good diabetic care can be achieved. The life span of the diabetic patient today can be practically normal.

Over and above the current program, a great deal must be done to accomplish the American Diabetes Association's four major objectives. For the immediate future, the association will seek an increase in the number of affiliate associations; an extension of the postgraduate course series, especially to regional and State levels; expansion of the diabetes detection drive; and an increase in the number of fellowships for research work.

National Sanitary Engineers' Register

At the request of the Office of Defense Mobilization, the Public Health Service is developing a National Register of Sanitary Engineers, as a phase of the program of the National Science Foundation.

In 1949, the American Public Health Association prepared a National Roster of Sanitary Engineers for the National Security Resources Board. Maintenance of that roster was discontinued a few years ago. The Public Health Service used that list and drew on the association's experience.

The American Public Health Association, the American Society of Civil Engineers, the American Water Works Association, the Federation of Sewage and Industrial Wastes Association, the Conference of Public Health Engineers, the Conference of State Sanitary Engineers, and the registration boards in each State have supplied their membership lists. A master mailing list of over 10,000 names of sanitary engineers has been developed from these and other sources.

A 1-page information sheet, prepared in cooperation with the Engineers' Joint Council and the National Science Foundation, will be sent to each engineer whose name is on this list. A letter from Assistant Surgeon General Mark D. Hollis, chief engineer of the Public Health Service, to accompany the information sheet, will ask each recipient to read the National Research Council's definition of a sanitary engineer before transmitting his reply. By this means, details on the engineer's education, his professional experience, and his sanitary engineering specialty will be recorded on the register.

The Specific Heat of Garbage

By E. ROBERT BAUMANN, Ph.D., and CHARLES S. OULMAN

LAWS or regulations in 45 States now require that garbage intended for animal feed be cooked to destroy pathogenic organisms. Most States require that the garbage be heated to a temperature of 212° F. and be held at this temperature for at least 30 minutes. To comply with these laws (*1*), hog feeders have built a wide variety of equipment for cooking garbage. Some of the garbage cookers show considerable ingenuity, but ingenuity alone is not enough for an efficient design. To evaluate the factors involved in the design of suitable equipment for the heat treatment of garbage, two research groups at Iowa State College have recently undertaken a project titled "Survival of Swine Disease Organisms in the Heat Treatment of Garbage." This study is being conducted by the Iowa Engineering Experiment Station and the department of veterinary medicine of Iowa State College under grant RG 3985 (C) from the National Institutes of Health.

One of the major factors to be considered in the design of a garbage cooker is the amount of heat required to destroy pathogenic organisms. The size of the burner used with direct-fired kettles and the amount of steam required for steam-injection cookers depends on the amount of heat that must be available to raise the temperature of the garbage to 212° F. The heat required to raise the temperature of the garbage without considering heat losses may be calculated by the following formula:

$$W \times \Delta T \times C_{pg} = \text{B.t.u. required}$$

when W = weight of garbage in pounds.

ΔT = 212° F. minus the temperature of garbage before cooking, degree F.

C_{pg} = specific heat of garbage in B.t.u. per pound per degree F. temperature rise.

B.t.u. = British thermal unit, the quantity of heat required to raise the temperature of 1 pound of water 1° F. at or near its point of maximum density.

Specific heat may be defined as the number of B.t.u. of heat required to raise 1 pound of a material 1° F. The specific heat of water is 1.0. The specific heat of almost all other materials, including garbage, is less than 1.0. The specific heat of garbage is not constant but will vary with the moisture content and the composition of the garbage solids. Since the moisture content of garbage will usually be between 65 percent and 85 percent (*2–4*), many engineers (*5*) have used a garbage specific heat of 1.0 for purposes of calculating heat requirements. Others, on the other hand, have based their calculations of heat requirements for garbage on specific heat values varying from 0.50 to 0.90 (*6*). No reliable bases for these assumptions have been reported in the literature.

In the study of the survival of swine disease organisms being conducted at Iowa State College, numerous types of equipment and cooking methods are being employed. Routine observa-

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tions are being made of heat losses and heat transfer coefficients obtained with each piece of equipment. A more accurate value of specific heat of garbage should be used to calculate these data with a reasonable degree of accuracy. The purpose of this paper is, therefore, to present a method for estimating the specific heat of garbage with sufficient accuracy for design purposes.

Specific Heats of Foods

Garbage fed to hogs is usually commercial garbage (*1*). Commercial garbage is obtained from restaurants, cafeterias, hospitals, hotels, and other public eating places. It is primarily waste food, and as such, the specific heat of the garbage should be very nearly the same as that of the food products that it contains.

The specific heats of many foods have been reported in the literature (*7–9*). For the most part, the specific heats vary approximately directly with the moisture content. When heated, food may be assumed to behave as a mechanical mixture of food solids and water (*10*). Some research workers have found that this assumption is in error for temperatures in the freezing zone, but the assumption will give good results for temperatures above 40° F. (*10*). The specific heat of food (and garbage) may be determined, then, by a weighted average of the specific heats of the food solids and of the water. On the basis of this assumption, specific heats, (C_p) of the solid portion of various foods were determined as follows:

EXAMPLE 1

Broccoli[1] (90 percent water, 10 percent solids)

Specific heat due to water ..... $0.90 \times 1.00 = 0.90$
Specific heat due to solids ..... $0.10 \times C_p = \text{---}$
Specific heat of broccoli (C_f)[1] $= .93$
Specific heat of food solids (C_p) $= \dfrac{0.93 - 0.90}{0.10} = .30$

[1] Reference 7.

Table 1 lists average values and ranges of values of percentage of moisture and specific heats for representative types of food products calculated from data reported by others (*7–9*).

The specific heats of most food solids vary from 0.15 to 0.45, with an average value of about 0.33. This rather wide variance in values can be explained by the high moisture content of food and the low specific heat of the food solids. On the average, the moisture content of food is about four times as great as the food solids content, and the specific heat of this water portion is about three times as great as the specific heat of the solids. Therefore, a relatively small variance in the determination of the moisture content of the food can produce a rather large variance in the determination of the specific heat of the food solids.

Table 1. Specific heats of foods

Food	Average values			Range of values		
	Percent moisture	C_f[1]	C_p[2]	Percent moisture	C_f	C_p
Meat	60. 1	0. 717	0. 343	20 –90	0. 48–0. 93	0. 150–0. 408
Fish and seafoods	71. 0	. 783	. 288	60 –80	. 72– . 90	. 200– . 486
Fowl	57. 2	. 750	. 420	52 –65	. 70– . 80	. 375– . 500
Vegetables:						
Green leafy	87. 6	. 930	. 302	65 –97	. 76– . 98	. 125– . 500
Squash, and so on	92. 6	. 932	. 295	83. 7–97	. 72– . 974	. 227– . 333
Beans and peas	51. 3	. 676	. 367	12 –92	. 85– . 91	. 182– . 677
Potatoes, carrots, and so on	85. 4	. 888	. 306	75 –95. 8	. 79– . 972	. 167– . 400
Fruit:						
Berries	79. 1	. 861	. 348	78 –94	. 53– . 92	. 118– . 800
Apples, pears, and so on	82. 5	. 891	. 366	65 –90	. 80– . 96	. 167– . 743
Oranges, lemons, and so on	88. 6	. 917	. 267	81 –92. 5	. 89– . 945	. 154– . 580
Dairy products:						
Milk products	58. 3	. 777	. 441	10 –87	. 64– . 92	. 267– . 683
Eggs	68. 5	. 783	. 310	48 –87	. 67– . 92	. 111– . 385
Bread	46. 0	. 67	. 388	44 –48. 5	. 65– . 68	. 375– . 418

[1] C_f—specific heat of the food.

[2] C_p—specific heat of the food solids.

EXAMPLE 2

Specific heat of broccoli, C [1]=0.93

Percent moisture	*Specific heat of food solids (C_p)*
91	0.22
90 [1]	.30
89	.36

[1] Reference 7.

Conversely, values of the specific heat of food solids that are considerably in error may be used without introducing an appreciable error in the value computed for the specific heat of the food. Table 2 lists nine foods and their respective specific heats. The specific heats of the foods in this table, as computed by using an average value of specific heat of 0.33 for the food solids, are compared with the specific heats that were reported by others (*7–9*). Two conclusions may be drawn from table 2. First, the variance in the calculated value of specific heat for a food is small when the average value (0.33) is used for the specific heat of the food solids. Second, the variances are smallest if the water content of the food is high.

Table 2. Variations in specific heats of foods

Food	Percent moisture	Specific heat of food	Computed specific heat of food	Percent variance
Beef, boiled [1]	57	0.73	0.71	2.7
Butter [1]	14	.49	.42	4.3
Ice cream [2]	67	.80	.78	2.5
Milk [2]	87	.92	.92	.0
Parsnips [2]	79	.86	.86	.0
Peas, green [2]	74	.85	.83	2.4
Potatoes, boiled [1]	80	.87	.87	.0
Strawberries [2]	90	.92	.93	1.1
White bread [1]	44	.65	.62	4.6

[1] Reference 8. [2] Reference 7.

Specific Heat of Garbage

The water content of garbage ordinarily varies from 65 percent to 85 percent (*2–4*). Since garbage solids are food solids, the specific heat of garbage solids may be expected to approximate 0.33, the average specific heat of food solids. It is proposed, therefore, that the average specific heat of garbage be calculated as shown in example 1, using a specific heat for the water of 1.0 and a specific heat for the solids of 0.33. Table 3 shows the relationship that exists between the percent of moisture in the garbage and the specific heat of the garbage if this assumption is made. The variances resulting from using the average value of specific heat for the food solids in the garbage should be rather small. The chart illustrates the variances resulting from using this average value for estimating the specific heat of a garbage for moisture contents of 65 percent and 85 percent. It also shows the variance in moisture content that will produce the same variance in the specific heat of the garbage.

EXAMPLE 3

The average value of specific heat of food solids, 0.33, is used to calculate the specific heat of a garbage whose actual moisture content is 85 percent. The calculated specific heat of the garbage would be 0.90. If the actual specific heat of the food solids is 0.218, the specific heat of the garbage would be 0.883.

Variance in specific heat of food solids, 51 percent.

Variance resulting in specific heat of garbage, 1.9 percent.

Variance in moisture content which would cause an equivalent variance in specific heat of the garbage, 3.0 percent.

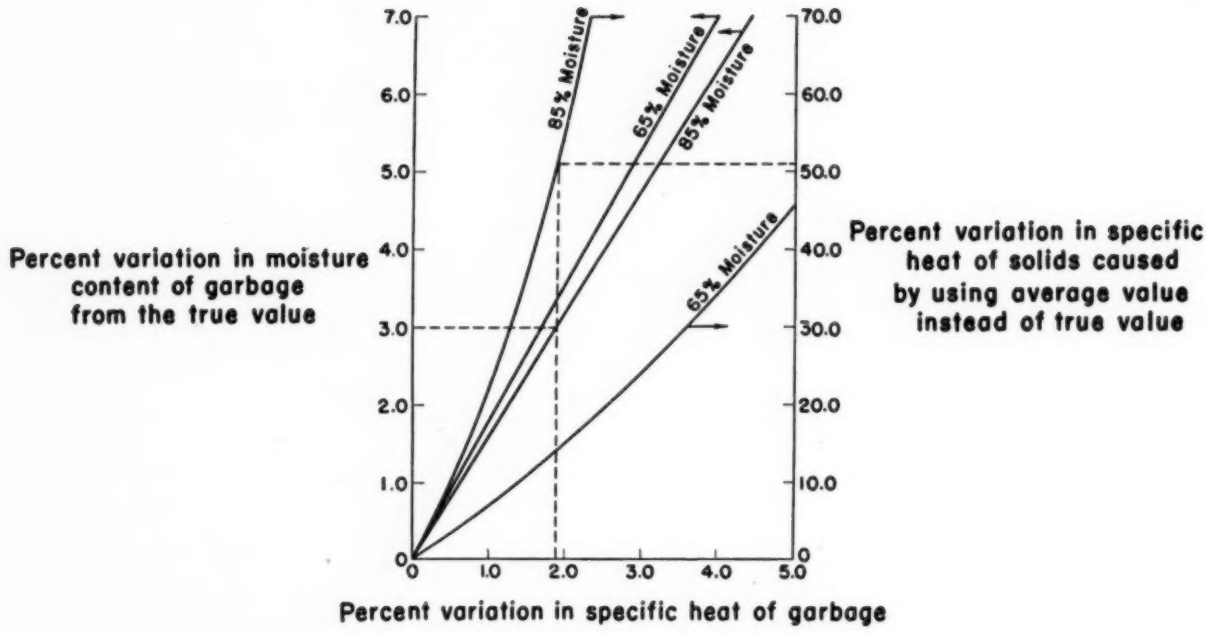
(This would result if a moisture content of 82.4 percent were used instead of the actual value of 85 percent.)

In most estimates of specific heat, the use of an average value of specific heat for the food solids should be sufficiently accurate. However,

Table 3. Relationship between moisture content and specific heat of garbage [1]

Percent moisture	Specific heat of garbage	Percent moisture	Specific heat of garbage
100	1.000	74	0.826
95	.97	73	.82
90	.93	72	.81
85	.90	71	.806
84	.89	70	.80
83	.886	69	.79
82	.88	68	.786
81	.87	67	.78
80	.866	66	.77
79	.86	65	.766
78	.85	60	.73
77	.846	55	.70
76	.84	50	.665
75	.83		

[1] Specific heat of water, 1.0; specific heat of garbage solids, 0.33.



if the makeup of the garbage is known, additional accuracy might be attained by computing a specific heat of solids for that particular garbage. Values of the specific heat of food solids can be used for computing this value if the approximate solids composition and moisture content of the garbage are known.

EXAMPLE 4

For a garbage known to contain:

Food	*Amount*	C_p[1]	
White bread	0.30	× 0.375	= 0.11
Potatoes	.30	× .350	= .11
Parsnips	.15	× .333	= .05
Peas	.10	× .423	= .04
Beef	.05	× .372	= .02
Milk	.05	× .360	= .01
Ice cream	.03	× .394	= .01
Butter	.02	× .407	= .01
		Average C_p	= .37

[1] C_p=Specific heat of food solids.

For a moisture content of 75 percent:

Specific heat due to water	(0.75×1.00)	= 0.75
Specific heat due to solids	(0.25×0.37)	= .09
Specific heat of garbage		= .84
Calculated specific heat of the garbage		= .83

Because the makeup of different lots of garbage from the same source will vary considerably, the use of an average specific heat of food solids in calculating the specific heat of garbage will probably give results as good as any that might be computed for it on the basis of its assumed makeup.

Laboratory Studies

To verify the accuracy of the calculated value of the specific heat of garbage, some experiments were run in the laboratory to determine the specific heat of several samples of garbage. In these tests, garbage samples were homogenized in a blender and tested in a homemade calorimeter. The laboratory tests were found to give a value of garbage specific heat within about 3 percent of the specific heat calculated on the basis of the proposed method. The proposed method should be checked, however, using a food calorimeter of the type in operation at the University of Texas (*10*).

Conclusions

1. The specific heat of garbage may be calculated with reasonable accuracy when the water fraction of the garbage is assumed to have a specific heat of 1.0 and the solids fraction is assumed to have a specific heat of 0.33.

2. The specific heat of garbage will normally range between 0.77 and 0.90 for moisture contents of 65 percent and 85 percent, respectively.

3. For determining the amount of heat re-

quired for cooking garbage, the specific heat should be assumed to be 1.0 if heat losses are not considered and 0.9 if heat losses are considered.

• • •

Tabulated values of moisture contents and specific heats for various foods may be obtained from the authors on request.

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To Develop Cancer Drugs

A national voluntary program of cooperative research and development to find and produce effective drugs for the treatment of cancer has been launched under sponsorship of the American Cancer Society, Atomic Energy Commission, Damon Runyon Memorial Fund for Cancer Research, the Veterans Administration, the Food and Drug Administration, and the Public Health Service National Cancer Institute.

General guidance of the program will come from the Cancer Chemotherapy National Committee, established May 14, 1955, as the top policymaking body. The committee will define the scope of the program, develop general policies, assist in obtaining financial support for the work, coordinate the activities of the sponsoring organizations, and observe the rate of progress of the entire effort.

The committee will be headed by Dr. Sidney Farber, scientific director of the Children's Cancer Research Foundation in Boston and also chairman of the Chemotherapy Committee of the National Advisory Cancer Council, Public Health Service.

Dr. Kenneth M. Endicott, National Cancer Institute, is executive secretary of the committee and in charge of the small full-time staff provided by the sponsoring agencies to administer the program, organize an information exchange, and give needed assistance to research scientists. Staff headquarters will be at the Cancer Chemotherapy National Service Center, National Institutes of Health, Public Health Service, Bethesda 14, Md.

Members of the committee are: Dr. Charles L. Dunham, Atomic Energy Commission; Mrs. Albert D. Lasker, National Advisory Cancer Council and American Cancer Society; Dr. Theodore S. Moise, Veterans Administration; Dr. C. P. Rhoads, Memorial Center for Cancer and Allied Diseases; Robert S. Roe, Food and Drug Administration; Dr. Antonio Rottino, Damon Runyon Memorial Fund; Mefford R. Runyon, American Cancer Society; and Dr. Leon A. Sweet, Parke, Davis and Company.

A comparative study of the efficiency of dry heat, dry heat and formaldehyde, and formaldehyde in a moist atmosphere for the sterilization of used bedding.

Efficiency of Dry Heat and Formaldehyde in Sterilizing Used Bedding

By ROBERT S. LLOYD, M.S., and MILTON J. FOTER, Ph.D.

DRY HEAT alone or in combination with formaldehyde is among the methods recommended for the sterilization of bedding materials by a number of State and local government agencies. This method, however, is subject to many procedural variations.

Little information has been published on the commercial sterilization or disinfection of bedding materials by heat or by heat and formaldehyde. Sprague (*1*) used formaldehyde gas to sterilize hair and feather pillows, mattresses, and blankets. He reported that the presence of moisture and the evacuation of the sterilizing chamber prior to the introduction of formaldehyde gas enhanced the effectiveness of formaldehyde on porous materials. He also recommended the use of at least one-fourth as much formaldehyde solution as the liter capacity of the chamber. Nordgren (*2*) stated that the sterilization of porous materials by formaldehyde gas could be attained only through previous evacuation of the sterilizing chamber. Gibbons and associates (*3*) reported that hot, moist air at 275° F. for 24 to 30 hours disinfected mattresses, and that the vaporization of 80 pounds of formalin per 1,000 cubic feet of capacity was more effective for sterilizing mattresses in an evacuated chamber than in a chamber under atmospheric conditions. The American Standards Association, Inc., Subcommittee on Bedding Sterilization (*4*) reported that only surface sterilization was achieved in mattresses exposed to 230° to 270° F. for ½ to 2 hours and that the combination of dry heat and formaldehyde at atmospheric pressure did not produce complete sterilization of mattresses even at elevated temperatures for prolonged exposure times.

Other methods of sterilization which have been considered include the use of ethylene oxide or mixtures of ethylene oxide and carbon dioxide (*5*), methyl bromide (*6*), and dielectric heat (*7*).

Mr. Lloyd is bacteriologist with the Milk and Food Protection Laboratory, Robert A. Taft Sanitary Engineering Center, Public Health Service, Cincinnati, Ohio. Dr. Foter is chief of the Aerobiology Unit, Bacteriology Section of the center.

Methods and Materials

Escherichia coli, *Staphylococcus aureus*, *Mycobacterium phlei*, and spores of *Bacillus globigii* and *Aspergillus niger* were employed as test organisms for bedding contamination. The nonsporulating species were grown in a liquid nutrient medium at 98.6° F. for 24 hours.

B. globigii and the mold species were grown in or on a special spore medium at 98.6° F. and 86.0° F., respectively, for 4 to 5 days. Filter paper strips (Whatman No. 3, 2¾ by ½ inches) were inoculated with 0.5 ml. of a cell or spore suspension. The culture strips were dried at room temperature and viable counts of the organisms on several strips picked at random were determined by agar plate procedure. The strips were then transferred to 4 by 2½ inch paper or cloth envelopes which were inserted in or on the bedding surface for exposure tests.

The presence of viable cells in the bacterial culture strips after exposure was determined by transfer from the envelopes to tubes containing tryptose-phosphate broth and glycerol broth, and the mold spore-inoculated strips were placed in neopeptone-dextrose broth. The tubes were then incubated for 1 to 2 weeks at the optimum temperature of the test organism. Subcultures of the exposed culture strips exhibiting growth were examined microscopically for identification of the surviving organism. Inoculated but unexposed culture strips were subcultured as controls. Test results were recorded as the survival or nonsurvival of the exposed organisms in the culture tubes after subculturing. Percentage survival of the exposed organisms was not determined.

Untreated, used cotton-felt and spring mattresses and specially made cotton-felt and spring mattress sections enclosed in zippered

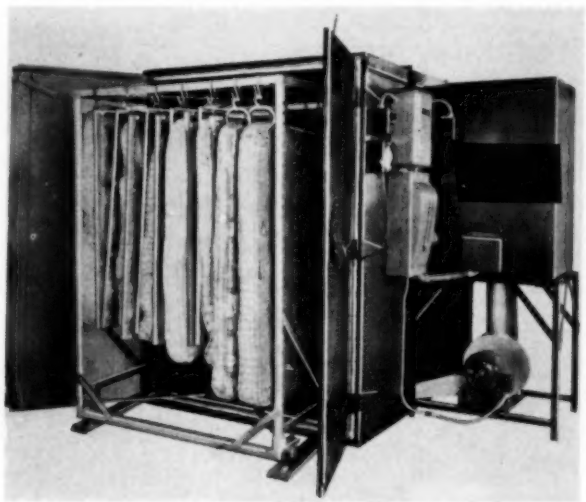


Figure 1. Electrically heated sterilizing chamber with 300 cubic feet capacity.

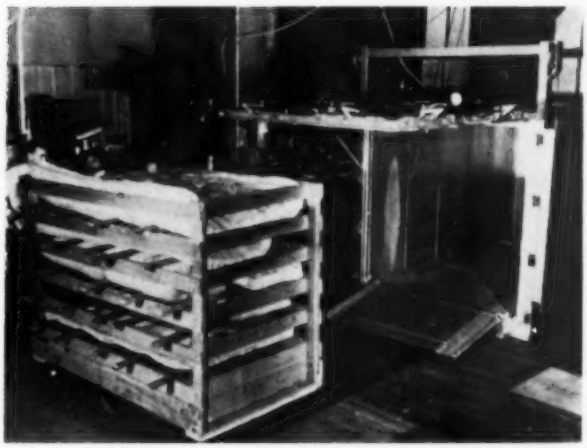


Figure 2. Nonpressure chemical sterilizing chamber with 300 cubic feet capacity.

mattress ticking were employed in the field studies. Samples of cored and uncored foam rubber (8½ by 4 by 1½ inches) wrapped in commercial mattress ticking were used in the laboratory studies. These materials were furnished by the Indiana State Board of Health, Indianapolis, Ind., and the Rubber Manufacturers Association, New York, N. Y.

Field Investigations

The major part of the field studies were conducted in commercial, nonpressure, mattress sterilizing chambers of approximately 300 cubic feet capacity (figs. 1 and 2). Air temperatures at several positions within the chambers were registered by recording thermometers. Temperatures on the surface and inside the bedding were measured by thermocouples.

Dry Heat

A number of the untreated, used mattresses and the zippered cotton-felt and spring mattress sections were placed horizontally on a mattress rack. Envelopes containing the inoculated and dried culture strips were attached to the surface of the top, middle, and bottom mattresses and inserted inside the zippered mattress sections. Additional thermocouples were also placed in these same locations to obtain temperature readings of the exposed bedding materials. The rack was transferred to a gas-heated chamber, which was equipped with a fan for circulating the air. Heat was introduced

until the desired test temperature, as recorded with a thermocouple unit, was reached inside the zippered spring mattress section. The exposure period was calculated from this point. Temperatures and exposure periods ranging from 230° F. for 2 hours to 270° F. for 1 hour were studied in these tests.

Dry Heat and Formaldehyde

In these studies, untreated, used cotton-felt and spring mattresses were suspended vertically from the mattress rack. Thermocouples and envelopes containing test culture strips were placed inside and on the mattress surfaces. The rack was then transferred to an electrically heated chamber, which was also equipped with a fan for circulating the air. Gaseous formaldehyde was generated by heating a liquid solution of 37 percent formaldehyde contained in a shallow dish on the chamber floor. Temperatures ranging from 230° F. to 250° F. for 1¼ to 2¼ hours and quantities of formaldehyde ranging from 1 pint to 1 quart per 1,000 cubic feet were tested.

To ascertain the formaldehyde concentration during the exposure periods, air samples were collected from the chamber at various intervals during the exposure period. Gas washing bottles, containing fritted glass disks and 100 ml. of 5 percent sodium bisulfite, were used to collect the chamber air from sampling ports located on one side of the chamber near the top, in the middle, and just above the chamber floor. The samples, collected at a rate of 8 liters per minute for 10 minutes, were analyzed for formaldehyde by the sulfoxylate method (*8*).

Table 1. Efficiency of dry heat in sterilizing contaminated mattresses

Test temperature and exposure time	Chamber location of culture	Survival following exposure				
		S. aureus	*E. coli*	*Myco. phlei*	*B. globigii*	*A. niger*
230° F.—2 hours	Top front	0	0	0	0	0
	Top back	0	0	0	0	0
	Bottom back	0	0	0	+	0
	Middle center	0	0	0	+	0
	Inside innerspring mattress	0	0	0	+	0
	Inside cotton-felt mattress	+	+	+	+	+
250° F.—1 hour	Top front	0	0	0	0	0
	Top back	0	0	0	0	0
	Bottom back	0	0	0	+	0
	Middle center	0	0	0	+	0
	Inside innerspring mattress	0	0	0	+	0
	Inside cotton-felt mattress	0	0	0	+	+
250° F.—2 hours	Top front	0	0	0	+	0
	Top back	0	0	0	+	0
	Bottom back	0	0	0	+	0
	Middle center	0	0	0	+	0
	Inside innerspring mattress	0	0	0	+	0
	Inside cotton-felt mattress	0	0	0	+	0
270° F.—½ hour	Top front	0	0	0	0	0
	Top back	0	0	0	0	0
	Bottom back	0	0	0	+	0
	Middle center	0	0	0	+	0
	Inside innerspring mattress	0	0	0	+	+
	Inside cotton-felt mattress	0	0	0	+	+
270° F.—1 hour	Top front	0	0	0	0	0
	Top back	0	0	0	0	0
	Bottom back	0	0	0	0	0
	Middle center	0	0	0	+	0
	Inside innerspring mattress	0	0	0	+	0
	Inside cotton-felt mattress	0	0	0	+	0

0 = No growth after subculturing and incubation for at least 1 week.
+ = Growth after subculturing and incubation for at least 1 week.

The experimental commercial chambers for the study were made available by James Miller, Fred Franke Co., Louisville, Ky. and Otis Auer, Docona Associates, Glen Ridge, N. J. Technical assistance in gas sampling and analysis and in the development of operational procedures was given by H. G. Porter and Bruce Turney, Indiana State Board of Health, Indianapolis, Ind. and John Perkins of the American Sterilizer Co., Erie, Pa.

Laboratory Investigations

Because of the increased use of foam rubber in bedding materials, laboratory tests were made to determine the physical effects of steam under pressure (248° F. at 15 pounds per square inch), dry heat (230° F.), and heat and formaldehyde in a humid atmosphere on foam rubber. Cored and uncored foam rubber samples, wrapped in mattress ticking, were employed in these tests. Unwrapped samples were also used for comparative purposes. Culture strips, containing the test organisms, were inserted in the samples to determine the bactericidal efficiency of formaldehyde and heat under moist conditions.

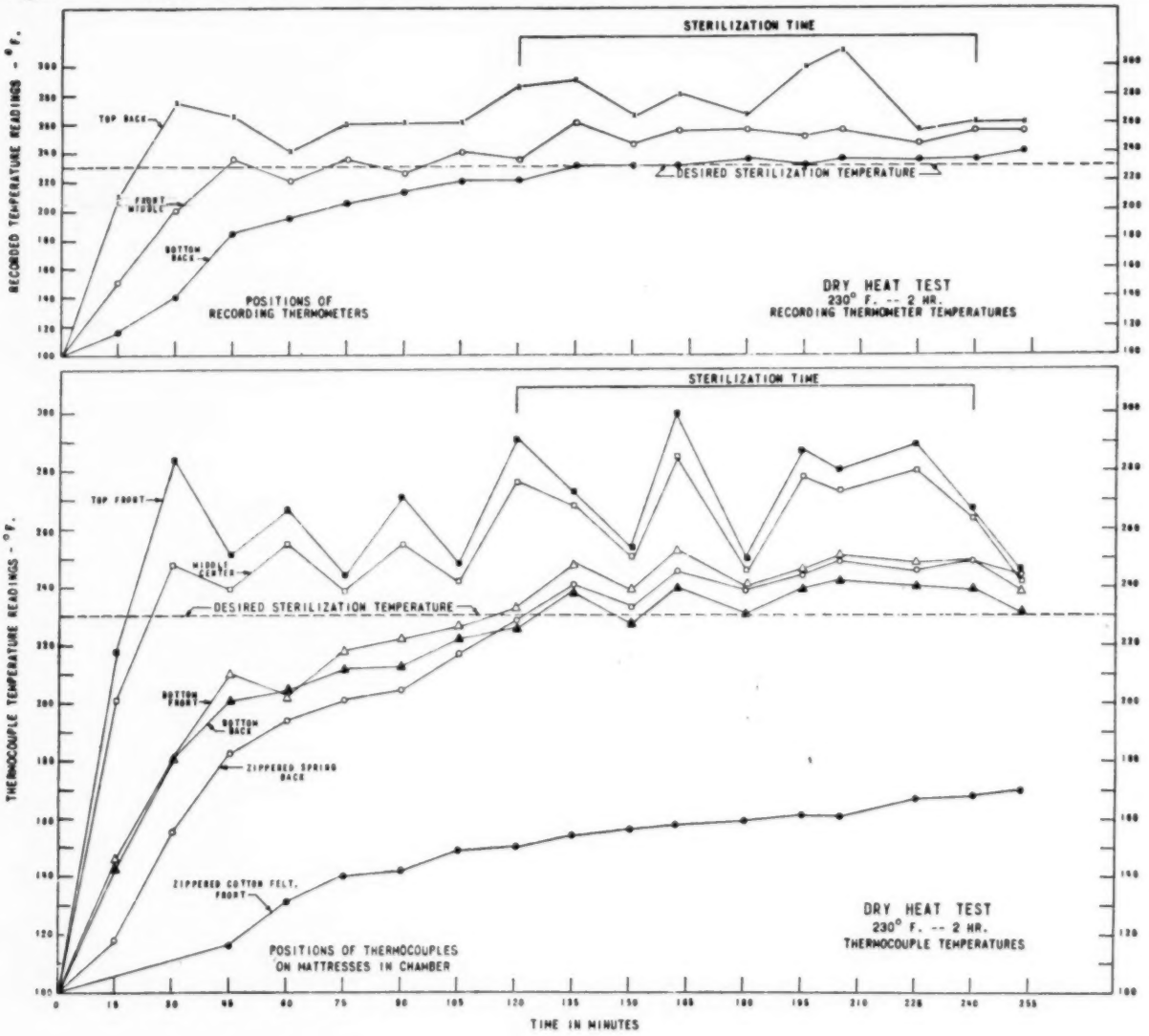
A standard laboratory hot air oven and an autoclave were employed in the heat and steam under pressure studies. The formaldehyde tests were conducted in a 1.5 cubic foot laboratory chamber in which liquid formaldehyde was vaporized from a shallow dish placed on the chamber bottom. Outlets were provided for

Table 2. Efficiency of heat and formaldehyde in sterilizing contaminated mattresses

Formalin [1]	Test temperature and exposure time	Chamber location of culture	Survival following exposure				
			S. aureus	*E. coli*	*Myco. phlei*	*B. globigii*	*A. niger*
1 pint per 1,000 cubic feet. 6 ounces per 300 cubic feet.	230° F.—1¼ hours	Top front	0	0	0	+	0
		Middle center	0	0	0	+	0
		Middle front	0	0	0	+	0
		Bottom back	0	0	0	+	+
		Inside innerspring mattress	0	0	0	+	+
		Inside innerspring mattress	0	+	+	+	+
1 pint per 1,000 cubic feet. 6 ounces per 300 cubic feet.	230° F.—2¼ hours	Top front	0	0	0	+	0
		Middle center	0	0	0	+	0
		Middle front	0	0	0	+	0
		Bottom back	0	0	0	+	0
		Inside innerspring mattress	0	+	0	+	0
		Inside innerspring mattress	0	0	0	+	+
1 quart per 1,000 cubic feet. 10 ounces per 300 cubic feet.	230° F.—2¼ hours	Top front	0	0	0	+	0
		Middle center	0	0	0	+	0
		Middle front	0	0	0	+	0
		Bottom back	0	0	0	+	0
		Inside innerspring mattress	0	0	0	+	0
		Inside innerspring mattress	+	+	+	+	0
1 pint per 1,000 cubic feet. 6 ounces per 300 cubic feet.	250° F.—1¼ hours	Top front	0	0	0	+	0
		Middle center	0	0	0	+	0
		Middle front	0	0	0	+	0
		Bottom back	+	+	0	+	0
		Inside innerspring mattress	+	0	0	+	0
		Inside innerspring mattress	+	0	0	+	0
1 quart per 1,000 cubic feet. 10 ounces per 300 cubic feet.	250° F.—1¼ hours	Top front	0	0	0	+	0
		Middle center	0	0	0	+	0
		Middle front	0	0	0	+	0
		Bottom back	0	0	0	+	0
		Inside innerspring mattress	0	+	0	+	0
		Inside innerspring mattress	+	+	+	+	0

[1] See reference 2.
0 = No growth after subculturing and incubation for at least 1 week.
+ = Growth of test culture after subculturing and incubation.

Figure 3. Representative temperatures obtained by dry heat in the sterilization of mattresses.



temperature measurements, air sampling, and internal pressure readings. The air samples, collected at 2 liters per minute for 3 minutes through fritted disk gas washing bottles containing 5 percent sodium bisulfite, were analyzed for formaldehyde by the method previously indicated.

Results

Dry Heat. Results of the commercial sterilization of bedding by dry heat are shown in table 1. Spores of *B. globigii* survived exposures of 230° F. to 270° F. for 1 to 2 hours except when the culture strips were located on the mattress surface near the top of the chamber. Nonsporulating cultures placed on mattress surfaces were destroyed under the test conditions. All cultures placed inside the cotton-felt mattress survived exposure at 230° F. for 2 hours.

Representative temperature data illustrate the elevation of temperatures at various locations in the chamber and in the mattresses (fig. 3). Temperatures of the chamber air and surface temperatures of mattresses placed near the top and in the middle of the rack increased rapidly to about 300° F. during the initial heating of the chamber. Surfaces of mattresses placed near the bottom of the rack required approxi-

mately 2 hours to reach the desired test temperatures. The desired test temperatures were never attained inside the cotton-felt mattresses exposed in the conducted tests.

No physicochemical tests were conducted to determine the effects of dry heat on exposed mattresses. Scorching was visible on the ticking of mattresses located near the top of the chamber where temperature readings ranged from 280° F. to over 300° F., which in most cases were considerably above the desired test temperatures. This indicated an uneven distribution of heat within the chamber during the exposure period.

Dry Heat and Formaldehyde. Spores of *B. globigii* survived in all the tests (table 2). The nonsporulating organisms were killed in all but one test when located on mattress surfaces but survived in some instances when placed inside spring mattresses.

Formaldehyde concentrations of the chamber air ranged from 30 to 90 mg. per cubic foot. Temperature readings during these studies were essentially the same as those shown in figure 3.

Results of Foam Rubber Tests. Discoloration, hardening and loss of elasticity and tensile strength were found in the foam rubber samples subjected to steam under pressure for a total of 3 hours or to dry heat at 230° F. for a total of 11 hours. Discoloration, brittleness, and drying of the mattress ticking were also noted.

No adverse effects were found in the foam rubber samples wrapped in mattress ticking and subjected for a total of 85 hours to formaldehyde gas (74 to 566 mg. per cubic foot) and heat (122° F. to 158° F.) at pressures of 0.56 to 4.1 pounds per square inch and at an indicated average of 50 to 90 percent relative humidity. Also no adverse effects were found in unwrapped samples of foam rubber exposed to approximately the same conditions.

Nonsporulating organisms and spores of *A. niger*, placed inside wrapped samples of foam rubber, were killed in 3 hours in the presence of about 440 mg. formaldehyde per cubic foot at 158° F. and an indicated average of 55 to 65 percent relative humidity. *B. globigii* spores survived. All test organisms were killed in 6 hours in the presence of 370 to 375 mg. formaldehyde at the same temperatures and relative humidity. The efficacy of formaldehyde in a heated, moist atmosphere currently is being studied in a gas-tight commercial, mattress sterilizing chamber of approximately 280 cubic foot capacity.

Summary and Conclusions

Results of an investigation have been presented comparing the efficiencies of dry heat, dry heat and formaldehyde, and formaldehyde in a moist atmosphere in the sterilization of used bedding materials under field and laboratory conditions using *Escherichia coli*, *Staphylococcus aureus*, *Mycobacterium phlei*, and spores of *Bacillus globigii* and *Aspergillus niger*.

Except for the organisms inside cotton-felt mattresses, dry heat at 230° F. for 2 hours in a commercial sterilizing chamber killed all nonsporulating test cultures. Spores of *B. globigii* survived all temperatures and exposure periods tested.

Considerable temperature variations were found in the bedding and in the chambers when the chambers were heated to the desired test temperatures.

The addition of formaldehyde in quantities of 1 pint to 1 quart per 1,000 cubic feet of chamber space did not enhance the sterilizing effects of dry heat alone.

Marked effects were noted in foam rubber when subjected to dry heat at 230° F. and steam under pressure (248° F. at 15 pounds per square inch). No adverse effects were observed when foam rubber was subjected to heat at 122° to 158° F. and formaldehyde in a moist atmosphere. No viable organisms were recovered from artificially contaminated foam rubber exposed to an average of 376 mg. formaldehyde per cubic foot for 6 hours at 149° to 158° F. and an indicated average of 60 to 65 percent moisture.

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technical publications

Directory of Full-Time Local Health Units, 1954

Public Health Service Publication No. 118. Revised 1954. 58 pages. 25 cents.

Revised July 1954, this directory brings up to date the listing of full-time health units serving local areas, together with the name of the health officer, or other designated administrative head, of each unit. The local units are listed by State, giving in each instance the health area jurisdiction, the post office address, and the health officer's name and his official title.

When the Migrant Families Come Again

A Guide for Better Community Living

Federal Interdepartmental Committee on Children and Youth publication. 1955. 27 pages; illustrated. 15 cents.

Addressed primarily to citizens in communities where there is a large annual influx of migratory farm and food processing workers, this pamphlet offers suggestions for building community programs to offer to the migrant worker and his family the basic things available to the average family—housing, good food, churches, schools, recreation facilities, and store services. It describes what some community groups have done to help meet the health, education, and welfare problems arising during the season the migratory workers and their families are in the areas. Health agency personnel and community leaders will find in the pamphlet information to stimulate program planning to fit their community's specific needs.

The Clinical Center

Current Studies and Patient Referral Procedures

Public Health Service Publication No. 284. Revised 1954. 24 pages. 10 cents.

Useful primarily to physicians, this leaflet describes briefly the principal research projects to which patients are currently being admitted for study and therapy at the Clinical Center of the National Institutes of Health, Bethesda, Md. The procedure for referral of patients and the eligibility requirements are also explained.

The Clinical Center is a modern facility shared by all seven of the institutes of health concerned with basic laboratory investigations and research in the fields of cancer, cardiovascular disease, mental health, neurological diseases and blindness, arthritis and metabolic diseases, microbiology, and dental health.

National Institutes of Health Annual Lectures, 1953

Public Health Service Publication No. 388. 1954. 102 pages. 45 cents.

Five lectures delivered in 1953 at the National Institutes of Health, Bethesda, Md., are published in this booklet: Tricarboxylic Acid Cycle—Enzymatic Mechanisms, by Severo Ochoa; Philosophy of the Clinical Trial, by A. Bradford Hill; Changes in the Vulnerability of Tissue—An Aspect of Man's Response to Threat, by Harold G. Wolff; Regulation of ACTH Secretion, by C. N. H. Long; and The Gold-Headed Cane in the Laboratory (the third R. E. Dyer lecture), by René J. Dubos.

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